AD-A282 875

The Department of Defense

DoD DEPARTMENTS/AGENCIES:

- Department of the Army
- Department of the Navy
- Department of the Air Force
- Advanced Research Projects Agency
- Defense Nuclear Agency
- BMDO Ballistic Missile Defense Organization
- Special Operations Command

SMALL BUSINESS INNOVATION RESEARCH PROGRAM (SBIR)

FY 1993 SBIR SOLICITATION

PHASE I AWARD ABSTRACTS

ARPA, DNA, BMDO, AND SOCOM PROJECTS

VOLUME IV

(1) (2B)

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PREFACE

This report presents the technical abstracts of the Phase I proposals that resulted in contract awards during Fiscal Year 1993 from solicitations of the Department of Defense (DoD) Small Business Innovation Research (SBIR) Program. The Army, Navy, Air Force, Advanced Research Projects Agency (DARPA), Defense Nuclear Agency (DNA), Ballistic Missile Defense Organization (BMDO, formerly SDIO), and Special Operations Command (SOCOM) are the DoD components of the SBIR Program. Two solicitations inviting small business firms to submit proposals under this program were published in FY93. Army, Navy, Air Force, ARPA, DNA, and BMDO participated in Program Solicitation 93.1 (Closing Date: 15 January 1993), and Army, Navy, ARPA and SOCOM participated in Program Solicitation 93.2 (Closing Date: 2 August 1993). The selection of proposals for funding was made from proposals received by the Military Services and Agencies.

FY 1993 SBIR PROGRAM

	Number of Topics		Proposals Received		Phase I Awards			
	93.1	93.2	93.1	93.2	91	92	93.1	93.2
Army	36	309	498	2,840	--	246	42	--
Navy	132	145	1,624	1,102	20	84	187	9
Air Force	188	--	2,996	--	--	4	466	--
ARPA	32	87	407	817	--	--	58	--
DNA	20	--	190	--	--	--	19	--
BMDO	16	--	767	--	--	--	147	--
SOCOM	--	3	--	37	--	--	--	3
Total	424	544	6,482	4,796	20	334	919	12
Grand Total	968		11,278		1,285			

As of the FY93 Annual Report (dated 15 March 1994), most of the FY93.2 proposals were selected but not yet awarded. The figures above show a quarter of the Phase I awards made in FY93 came from the FY91 and FY92 solicitations. Of the 1,285 Phase I awards made in FY93, 258 awards (approximately 20 percent) went to minority-owned or woman-owned businesses.

In order to make information available on the technical content of the Phase I projects supported by the DoD SBIR Program, four volumes containing the abstracts and contracts for the awarded projects are published. The small business information with accompanying abstract are arranged in alphabetical order by firm name. Cross reference indices appear at the back of the volume for quick reference.

- Volume I contains Army Projects
- Volume II contains Navy Projects
- Volume III contains Air Force Projects
- Volume IV contains ARPA, DNA, BMDO, and SOCOM Projects

Venture capital and large industrial firms that may have an interest in the research described in the abstracts in this publication are encouraged to contact the firm whose name and address is shown.

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INTRODUCTION

In 1982, Congress enacted and the President signed the "Small Business Innovation Development Act of 1982" (Public Law 97-219), which created the Small Business Innovation Research (SBIR) Program to give small, high-technology firms a greater share of the federally-funded research and development contract awards.

Under the SBIR Program, each federal agency with an extramural budget for research or research and development in excess of $100 million per fiscal year must establish an SBIR Program. The program is currently funded by setting aside 1.5 percent of the participating agency's extramural R&R&D contracting dollars. The agencies participating in the Department of Defense SBIR Program are the Army, Navy, Air Force, Advanced Research Projects Agency (ARPA), Defense Nuclear Agency (DNA), Ballistic Missile Defense Organization (BMDO, formerly SDIO), and Special Operations Command (SOCOM).

The objectives of the DoD SBIR Program include stimulating technological innovation in the private sector, strengthening the role of small business in meeting DoD research and development needs, encouraging participation by minority and disadvantaged persons in technological innovation, and increasing the commercial application of DoD-supported research or research and development.

The SBIR Program consists of three distinct phases. Under Phase I, DoD components make awards to small businesses, typically of up to one man-year of effort over a period of six months, subject to negotiation. Phase I is to determine, insofar as possible, the scientific or technical merit and feasibility of ideas or concepts submitted in response to SBIR topics. Proposals selected for contract award are those which contain an approach or idea that holds promise to provide an answer to the specific problem addressed in the topic. Successful completion of Phase I is a pre-requisite for further DoD support in Phase II.

Phase II awards will be made only to firms on the basis of results from the Phase I effort, and the scientific and technical merit of the Phase II proposal. Proposals which identify a follow-on Phase III funding commitment will be given special consideration. Phase II awards will typically cover two to five man-years of effort over a period of 24 months, also subject to negotiation. The number of Phase II awards will depend upon the success rate of the Phase I effort and availability of funds. Phase II is the principal research or research and development effort, and requires a comprehensive proposal outlining the intended effort in detail.

In Phase III, an innovation is brought to the marketplace by private sector investment and support. No SBIR funds may be used in Phase III. Also, under Phase III, DoD may award follow-on contracts with non-SBIR funds for products and processes meeting DoD mission needs.

Proposals received in response to a DoD solicitation are evaluated on a competitive basis in the organization which generated the topic, by scientists and engineers knowledgeable in that area. Selections for Phase I are made in accordance with the following criteria:

- The soundness and technical merit of the proposed approach and its incremental progress toward topic or subtopic solution.
- The potential for commercial (government or private sector) application and the benefits expected to accrue from this commercialization.
- The adequacy of the proposed effort for the fulfillment of requirements of the research topic.
- The qualifications of the proposed principal/key investigators, supporting staff and consultants. Qualifications include not only the ability to perform the research and development but also the ability to commercialize the results.

The "Small Business Innovation Act of 1986" (P.L.97-443) extended the "Sunset Clause" to 1993 and increased the taxation of the extramural research and development budget to 1.25 percent. The latest SBIR re-authorization law (P.L. 102-564), signed October 28, 1992, extends the program through 2000, doubles the taxation to 2.5 percent by 1997, and increases the average Phase I and Phase II award agreements.

(7) DB

ABJ INTEGRATION TECHNOLOGIES
7550 CHAPARRAL DRIVE
ATLANTA, GA 30350
Phone: (404) 872-5491
Topic#: 93-021 ID#: 9310385
Office: MTO
Contract #: DAAH01-93-C-R196
PI: AXEL THOMSEN
Title: Self-routing Optical Crossbar Switch
Abstract: High speed, low cost optical self routing optical crossbar switches with gigabit data rates are key components in optical communication and routing systems. We propose to fabricate and study a monolithically integrated optical crossbar switch which will be inexpensive and high performance. This integrated switch utilizes thin film emitters and detectors integrated directly onto a host integrated circuit. The ultimate performance of this switch will not be limited by the reactance of the wirebond connections that plague conventional hybrid packaged schemes, since the proposed switch is monlithically integrated without wirebonds. ANTICIPATED BENEFITS: Low cost, high performance optical crossbar switches for optical communication networks.

ACSIST ASSOC., INC.
3965 MEADOWBROOK ROAD
ST. LOUIS PARK, MN 55426
Phone: (612) 931-1334
Topic#: 93-014 ID#: 9310253
Office: ESTO
Contract #: DAAH01-93-C-R197
PI: CARL REYNOLDS
Title: Multi-chip Integration
Abstract: The goal of this research project is to determine the viability of an interconnect and probing technology which could be used to test and burn-in unpackaged semiconductors at system level speed, and at operating frequency, with voltage and with temperature margins verified. The focus of the research will be to address directly the most costly limitation to widespread MCM use; the problem of readily determining "known good die" (KGD). The scope of the Phase I research is to investigate the viability of an integrated interconnect technology designed to contact and test one to several unpackaged die. A significant challenge is to develop the ability to probe the pads without damaging the bond or compromising device reliability. The selected interconnection and probing technology must be suitable for use in both room temperature and thermal cycling; and in static high temperature environments up to 165 degrees C. The technical challenges vary depending on whether the integrated circuit device is destined to be attached to the next level package by wire bonding, TAB or a form of flip chip attachment. ANTICIPATED BENEFITS: ACSIST believes that it will be able to commercialize a proven interconnect method for contracting one to several unpackaged die without damage to the attachment pads which is suitable for use in a wide range of temperature environments for the realization of the KGD concept.

ADVANCED PROCESSING LABORATORIES, INC.
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VIENNA, VA 22182
Phone: (703) 442-0892
Topic#: 93-027 ID#: 9310402
Office: SSTO
Contract #: DAAH01-93-C-R198
PI: WILLIAM MAHOOD
Title: Voice Authentication Monitoring System
Abstract: Speech deception and voice "hijacking" techniques are now sophisticated beyond the ability of any single detection methodology. Deceptive speech detection requires an array of analysis tools to collectively provide an acceptable probability of detection. An effective Voice Authentication Monitoring System is envisioned as a "work bench" tool set to detect, analyze and assess speech deception. Development of a single methodology which exploits articulatory trajectories of individual speakers in analyzing continuous, "unwitting" speech has potential of superior performance involving voice authentication, speech verification and recognition. ANTICIPATED BENEFITS: The proposed research will yield a new tool methodology that will facilitate the development of a Voice Authentication Monitoring System. The technique of speech featuring a trajectory mapping is applicable to law enforcement, drug intradiction and counter terrorist efforts.

ADVANCED TECHNOLOGY MATERIALS, INC.
7 COMMERCE DRIVE
DANBURY, CT 06810
Phone: (203) 794-1100
Topic#: 93-011 ID#: 9310331
Office: DSO
Contract #: DAAH01-93-C-R199
PI: JOHN STEINBECK
Title: Residual Stress/fracture Modeling of HTSC Films

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Abstract: High quality thin films of high temperature superconductor (HTSC) materials have been grown by a variety of methods. Independent of the growth method, residual stresses in large area HTSC/dielectric multi-layer films, resulting from both thermal expansion and lattice mismatch, continue to be a problem. In Phase I, ATM, working with Dr. Stewart Kurtz of Pennsylvania State University, will calculate residual stress in the HTSC films using a three dimensional model based on the Voronoi tessellation method, which Dr. Kurtz has applied to the analysis of residual stress in multilayer capacitor structures with great success. Local stress distributions in the HTSC films will be predicted as a function of texture, grain size (to the limit of single crystal growth), layer thickness, directional thermal expansion coefficient, and material physical constants. Interlayer and intralayer fractures can then be predicted from analysis of local stress distributions. In Phase II the model will be refined as a computational tool and applied to the HTSC multichip module fabrication problem. As appropriate, a wider range material systems and more complex device geometries (including vias and trenches) will be examined. HTSC/multilayer structures will be grown, residual stresses measured and corrected with the predictions of the model. ANTICIPATED BENEFITS: Residual stress/delamination continues to be a major concern of many commercial thin film coating processes. Computational models which can predict conditions leading to delamination or handling problems will save large sums of money spent on empirical development studies.

ANALYTICAL DESIGNS, INC.
194 N. SUNNYVALE AVENUE
SUNNYVALE, CA 94086
Phone: (408) 732-2927

Topic#: 93-031 ID#: 9310313
Office: MSTO
Contract #: DAAH01-93-C-R200
PI: BRIAN HOWLEY

Title: Intelligent, Modular, Scalable Controllers and Actuators for Use in Automated Systems

Abstract: An intelligent, redundant end effector is proposed for use as part of an intelligent automation system. The end effector is compact, lightweight, and provides up to six degrees of freedom over a limited workspace. The design is modular being composed of a number of interchangeable linear actuators which can be scaled to accommodate different force, bandwidth, and accuracy requirements. Phase I technical objectives are to demonstrate the feasibility of the proposed design and to trade design configurations and controllers against size, weight, power, and computation complexity metrics. Phase II objectives will be to build and demonstrate the proposed end effector's performance within a hierarchically controlled system. Phase I tasks include fabrication and testing of an innovative linear actuator, which is a key element of the end effector design, and the development of the software algorithms and algorithms and analysis tools. Improvements and enhancements to the actuator and end effector designs will be sought. Anticipated Phase I results include development of an end effector mechanism and controllers, and successful preparation for Phase II tasks. ANTICIPATED BENEFITS: Intelligent control lowers the cost, improves the performance, and increases accessibility of commercial automation systems. Commercial applications extend to nearly all industrial robot and automation systems proposed in this SBIR.

APPLIED TECHNICAL SYSTEMS, INC.
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PORT ORCHARD, WA 98366
Phone: (206) 674-2022

Topic#: 92-218 ID#: 9220707
Office: SSTO
Contract #: DAAH01-93-C-R023
PI: LANCE OTIS

Title: Mapping Object-Structured Information Among Applications

Abstract: Applied Technical Systems, Inc. is presently performing research in the optimization of object-oriented representations among database applications. We have developed a prototype database which can be used as a "meta-database," in that it can incorporate the object structures for multiple databases and can provide a method for automatically optimizing the object structure for a specific task or user perspective. This project proposes to expand on this research work to adapt the model to a wider set of complex real-world applications that include modern object-oriented programming, database, and expert systems. Leveraging off the existing research, we propose to devise methods for analysis, customization, conversion, and optimization of any system's underlying object structure for each task and from one task set to another. In turn, the project proposes automating and integrating these methods into a database management scheme that will provide joint accessibility to each or all of these items mapped to each task or user for his particular perspective with no information loss, while assuring speedy query, speedy update, data integrity, syncronicity, and data persistence. Deliverables will be in the form of research reports, prototype software demonstrations, and recommendations for further research work. ANTICIPATED BENEFITS: Devising methods for analysis, customizing, converting, and optimizing the system's underlying object structure for each task and from one task set to another and in turn automating and integrating these methods into a database management scheme will improve the capability

to model complex real-world situations. This could provide improved support in areas such as: industrial business management, medical research of symptoms vs. causes, law enforcement criminal tracking, and defense intelligence analysis.

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Phone: (301) 644-2400
Topic#: 93-026 ID#: 9310075
Office: SSTO
Contract #: DAAH01-93-C-R201
PI: EDWIN ADDISON
Title: Natural Language Text Retrieval Using A Large Semantic Network
Abstract: In the 1980s, two independent developments in text retrieval attempted to improve Boolean searching. These were statistically searching, which allowed users to enter requests in plain english and retrieve documents based upon the statistical occurrence of words; and concept based searching, which requires users to define concepts in a knowledge base and perform searches by entering a concept by its name. Both of these methods made some improvements in accuracy, but placed additional burden on the user. Statistical searching has not been readily accepted because it is difficult to explain the results. Concept based searching requires extensive labor to build the underlying "knowledge base" of search concepts. ConQuest Software, by using retrieval software, called ConQuest (TM), that includes the best of both statistical and concept based searching, but also eliminated the need for users to build a knowledge base. The objective of this effort is to combine ConQuest with new processing to reach breakthrough levels of precision and recall accuracy by exploiting the power of a large semantic network that includes, but is not limited to the contents of WordNet. The research results will demonstrate that linguistically based text retrieval systems have a higher upside potential than purely statistically based systems. ANTICIPATED BENEFITS: The proposed system is useful to the Government in many ways: it enhances research programs such as TIPSTER, it provides a capability for intelligence agency work, it provides document management, and it manages information (DTIC). The commercial market for text retrieval is rapidly growing and has applications spanning corporate intelligence, legal, regulatory, marketing, and document management.

COOPERATING SYSTEMS CORP.
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ARLINGTON, MA 02174
Phone: (203) 393-2486
Topic#: 93-007 ID#: 9310016
Office: CSTO
Contract #: DAAH01-93-C-R202
PI: MARINA CHEN
Title: Hi-C++: An Object-oriented Programming Environment For High Performance Platforms
Abstract: This research project uses object-oriented technology to enable the creation of production quality commercial software for high performance computing (HPC) hardware. Primary concerns include ease of use, platform flexibility, and high performance. The investigation focuses on a C++ programming environment, called Hi-C++, scalable and portable over a variety of HPC platforms ranging from workstation clusters to massively parallel machines. The Hi-C++ approach makes use of detailed structural and contextual analysis of each program segment, with run-time implementations designed to exploit this special knowledge to gain high performance. The proposed concepts will be proven via commercial applications written in Hi-C++. The compiler/run-time system know-how and infrastructure required are advantages unique to Cooperating Systems Corporation. ANTICIPATED BENEFITS: The proposed software solution lowers the risk and long-range cost of HPC and makes it truly useful for commercial as well as defense applications. Modeling and simulation in production, manufacturing, engineering, and financial instrument trading will all benefit.

CRYSTACOMM, INC.
1599 N. SHORELINE BLVD.
MOUNTAIN VIEW, CA 94043
Phone: (415) 961-4311
Topic#: 93-012 ID#: 9310363
Office: ESTO
Contract #: DAAH01-93-C-R230
PI: GEORGE ANTYPAS
Title: "Large Diameter (3"), Indium Phosphide, (100) Oriented Single Crystal Growth"
Abstract: Based on the extensive experience related to the growth of low defect density 2" diameter Indium Phosphide, (InP), crystals, we propose to optimize the thermal environment that was recently developed at CrystaComm for the growth of three inch diameter InP crystals. Growth parameters such as temperature gradients, inert overpressure levels and boric oxide thickness will be investigated. One to two kilogram (100) oriented InP crystals will be grown in this improved environment and will be characterized, as to the defect density by wet chemical and x-ray topographic techniques. Polished sample wafers will be

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supplied to designated laboratories for evaluation and epitaxial growth. ANTICIPATED BENEFITS: Successful completion of Phase II will make possible the commercial availability of 3", (100) oriented InP wafers of comparable quality that is presently available in wafers less than 2" in diameter.

CYBERNET SYSTEMS CORP.
SUITE B-101, 1919 GREEN ROAD
ANN ARBOR, MI 48105
Phone: (313) 668-2567

Topic#: 93-029 ID#: 9310124
Office: SSTO
Contract #: DAAH01-93-C-R231
PI: BRIAN MITCHELL

Title: Human-centered, Task-specific Visual Planning For Robotic Applications

Abstract: The development of an Active-Vision, Task-Specific planning system is proposed. This scheme is based on a human-centered approach to obtaining insight into task-specific vision control strategies using eye-tracking hardware. This idea is coupled with computer vision and artificial intelligence frameworks to produce a task-specific programmable system for planning and allocating resources to produce computationally efficient and robust solutions to vision tasks. The results of this project are expected to produce both hardware and software components that can be applied to a wide range of both military and commercial robotic applications. ANTICIPATED BENEFITS: Within the military, space, and commercial sectors, active vision technology can be used to support any robotic activity. In the military it could provide the basis for sensor allocation to support both the navigation and RSTA activities for the robotic land vehicles. In space, it could aid in such applications as spacecraft docking and robotic spacecraft repair. In the commercial world, the technology developed will be applicable to robotic construction and earth moving equipment.

DANIEL H. WAGNER ASSOC., INC.
894 ROSS DRIVE, SUITE 205
SUNNYVALE, CA 94089
Phone: (408) 745-1800

Topic#: 93-027 ID#: 9310391
Office: SSTO
Contract #: DAAH01-93-C-R232
PI: ROBERT LIPSHUTZ

Title: Voice Authentication Monitoring System

Abstract: This work will demonstrate a novel signal processing paradigm for voice authentication. In addition, a statistical analysis technique for the evaluation and improvement of any authentication method will be developed, along with a preliminary database to support the evaluation. This includes a method for constructing a reference identification database, and a method for continuously scanning a speaker's voice to authenticate their identity. Software will extract a predetermined set of sounds which uniquely specify certain physiological characteristics of the speaker. These sounds will be processed to obtain a set of discriminating parameters unique to a specific individual's voice, yet flexible enough to allow changes which occur during normal speech. The authentication decision will be made by a neural network using the discriminating parameters. The network will take advantage of the flexibility and reliability of the proposed techniques. The training and testing of the network will be achieved using the aforementioned database. ANTICIPATED BENEFITS: The ability to reliably verify the identity of an individual based on a small, quickly computable set of parameters has numerous applications in the military and civilian sectors. These include enhanced communication security; operator ID verification for voice controlled equipment; and customer ID verification for bank and credit cards.

DEFENSE RESEARCH TECHNOLOGIES, INC.
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ROCKVILLE, MD 20850
Phone: (301) 762-3077

Topic#: 93-018 ID#: 9310400
Office: MICOM
Contract #: DAAH01-93-C-R233
PI: TADEUSZ DRZEWIECKI

Title: Missile Flyout Trajectory Visualization Tool

Abstract: It is often difficult to readily determine many important, but subtle, responses of missiles from telemetry data alone. Therefore, accept missile simulation/telemetry data and reconstruct an animation of the events that occurred during the flight/engagement. In order to do this, DRT will define a generic set of simulation outputs which will cover the full range of anticipated flight characteristics. A file format will be defined allowing for maximum flexibility and ease of interface with available data. Data processing modules will be developed to accept trajectory data and reconstruct the flight of the missile using two- and three-dimensional time based animation. The user would interactively choose view angles, field of view and speed of replay (real-time, fast-motion, slow-motion). Depending on the missile flight characteristics of interest including

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accelerations, angles of attach, fin movements, multistage separation events, etc. Utilizing DRT's Sensor Performance Visualization software, sensor fields of view will be reconstructed. Data processing modules will be written so that they can be used as the building blocks during Phase II development of the fully operational simulation modeling tool. An initial user interface will be developed to allow visualization of data processing module output. Based on this simple interface, plans will be developed and refined for an optimal windowed interface to be developed in Phase II. DRT plans to utilize output data from its in-house 6DOF simulation package as well as simulation and telemetry data provided by DARPA. All software development will be undertaken using C/C++ to allow for maximum compatibility with the computer world, and portability to Microsoft Windows and Windows NT. Development will emphasize creating a package which can run on a variety of computing platforms including 486 PCs for maximum usefulness. ANCITICPATED BENEFITS: The successful development of the DRT missile simulation post-processing tool will enable users in the government and private sectors to review missile flight data in a manner which is not currently widely possible. Either as a stand-alone package or combined with DRT's 6DOF simulation, this tool will fill a void in the simulation market and provide a wider base of simulation users the power to analyze complex missile engagements.

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320 NEVADA STREET
NEWTON, MA 02160
Phone: (617) 965-5200

Topic#: 92-216 ID#: 9220882
Office: SSTO
Contract #: DAAH01-93-C-R101
PI: JANET BAKER

Title: Semi-automated Speech Transcription Systems

Abstract: Dragon Systems will explore the transcription process, survey some available data and materials, and analyze potential transcription aids incorporating large vocabulary continuous automatic speech recognition. Dragon systems will also acquire some selected data and perform some relevant recognition experiments using broadcast material. ANTICIPATED BENEFITS: Transcription of recorded speech has wide applications throughout the federal government, both military and civilian agencies. In addition to being valuable for intelligence applications, it is useful in any office setting. Captioning of television broadcasts is an application for the hearing impaired that is supported by several government agencies.

DURATECH, INC.
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DECATUR, GA 30033
Phone: (404) 299-3315

Topic#: 92-188 ID#: 9220871
Office: MICOM
Contract #: DAAH01-93-C-R102
PI: ROBERT HOCHMAN

Title: Flexible Circuit Reliability Enhancements Using Pulsed Magnetic Treatments

Abstract: Flexible circuits, used as system interconnects, can suffer reliability problems due to repeated flexing. These circuits which are designed to bend can break the conductor traces transmitting signals between circuits. This proposal will investigate whether this low cycle fatigue problem can be minimized by pulsed magnetic treatments. Pulsed magnetic treatments have been shown by positron annihilation spectroscopy, PAS to change the metallurgical defect concentration and stress relieve metals like copper and nickel. This technique has the potential to decrease the defect density at low temperatures. The typical flexible circuit is not a candidate for thermal annealing since annealing temperatures will degrade the dielectric. Our approach in this proposed effort is to perform partial fatigue tests of realistic electronic constructions through the use of flexible ductility testers, perform various amounts of pulsed magnetic treatments and determine the efficacy of the treatments to extend fatigue life. A second goal of the Phase I contract will be to determine the cost effectiveness of the treatment and whether the increased lifetime for each circuit is justified over simply replacing it at periodic intervals. ANTICIPATED BENEFITS: Extended fatigue life through exposure to pulsed magnetic treatment will translate into lower overall system cost for military and commercial electronic hardware since the need for replacement will decrease.

EIC LABORATORIES, INC.
ILL DOWNEY STREET
NORWOOD, MA 02062
Phone: (617) 769-9450

Topic#: 93-010 ID#: 9310224
Office: DSO
Contract #: DAAH01-93-C-R234
PI: STUART COGAN

Title: Thin Film Batteries for Microelectronics

Abstract: The development of thin film, solid state batteries for microelectronic applications is proposed. The batteries will be

fabricated on ceramic substrates suitable for encapsulation in integration circuits using lead frame technology or as discrete components in multichip modules. The batteries are based on a secondary (rechargeable) lithium system that incorporates a high charge capacity oxide cathode and a carbon anode, both deposited by low temperature processes. The principal short term military application for the batteries would be memory protection for CMOS static random access memory (SRAM) in the event of primary power loss. The Phase I program will fabricate and characterize single cell batteries deposited on Si substrates. These batteries will provide O.1 MA-HR at a cell voltage >2V, which is sufficient to maintain 1 megabyte of low power SRAM for more than 24 hours. Battery materials and a multilayer hermetic coating have been chosen to meet military specifications on thermal and environmental stability of integrated circuit components. The Phase II effort would focus on the optimization of battery performance, maximizing both capability, and integrating multiple cells onto a single substrate to allow series and parallel battery configurations to achieve higher cell voltages or greater rate capabilities. ANTICIPATED BENEFITS: Many critical or portable data storage and miniaturized electronic devices will benefit from the availability of thin film batteries. Commercial applications of the proposed technology are many. Personal computers, portable communications, and portable data storage systems will all use thin film batteries either for memory backup or as a secondary power source.

ELECTRO SCIENCE APPLICATIONS, INC.
3868 CARSON STREET, SUITE 112
TORRANCE, CA 90503
Phone: (310) 547-4205

Topic#: 93-008 ID#: 9310181
Office: DSO
Contract #: DAAH01-93-C-R235
PI: ROBERT CHAMPETIER

Title: Absolute Non-contact Temperature Measurements with a New Polarizing Radiation Pyrometer

Abstract: A completely new method is proposed to remotely measure the true temperature of substrates during chemical vapor deposition (CVD) processes. Conventional radiation pyrometry is not adequate since it requires that the sample be optically polished (specular) and opaque at the measurement wavelengths. These conditions are met for semiconductor and metallic substrates and coating materials of interest in CVD. The method requires a special photometer incorporating a rotating linear polarizer, and a lamp with a black body calibration, both external to the chamber. True surface temperatures are obtained, which permit tracking of wafers an other substrates during CVD deposition, which in general results in significant variations in spectral emissivity. The signal, noise sources, and observation times lead to an expected repeatability and precision better than 1oC are feasible as well. A modified mode of operation can provide surface temperature profile scans with 0.1oC precision. These parameters are a major improvement in radiation pyrometry, and suggest (1) application to feedback control of CVD for intelligent processing of materials, and (2) a very likely commercial instrument for world wide sales. ANTICIPATED BENEFITS: This technique overcomes inaccuracies in conventional radiation pyrometry. Consequently, there are numerous potential applications in industry and science, which now utilize a range of commercial non-contact instruments. The method is perfectly general and can be applied at longer wavelengths and colder temperatures by suitable adaptation of the instrument parameters.

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Topic#: 93-014 ID#: 9310405
Office: ESTO
Contract #: DAAH01-93-C-R236
PI: IGOR KADIJA

Title: Direct Electroplating of Interconnects - An Efficient New Technology for Advanced MCMS

Abstract: This proposed development will result in the first production process for direct electroplating of copper interconnects for microelectronics manufacturing. Technology for direct electroplating processes will be developed. The direct electroplating of interconnects with the ECSI proprietary process produces the highest attainable interconnect conductance. The ECSI process does not need the conventional conducting metalization for cathode current return. By eliminating the need for a common current collector the process significantly simplifies design and manufacturability. Also, this process reduces the importance of current thieves in the plating geometry and in many cases the thieves are potentially eliminated. As a result packaging density can be increased. The elimination of the common current collector connections makes many electroforming applications feasible that otherwise are impossible. The major technology, demonstrations and development milestones are: (1) Establish process for direct electroplate activation of substrate (e.g., utilize the Black Hole (TM) technology by MacDermid, Conductron DP(TM) by LeaRonal or other process) required for direct electroplating of interconnects. (2) Direct electroplate high density, 10 to 100 micrometer lines and vias on silicon, ceramic and organic substrates. (3) Apply direct electroplating technique with nickel and gold or other metals for interconnects metal finishing. (4) Develop plan to demonstrate the utility of this capability

in collaboration with an end user. (5) Prepare business plan to ensure commercial availability of manufacturing equipment. ANTICIPATED BENEFITS: This technology will have its largest market in multichip modules MCMs. Multichip modules are increasingly being designed into military systems. Next generation computer workstations will utilize more MCMs and Supercomputer manufacturers including Cray and IBM. Direct eletroplating of interconnects by this efficient ECSI process will play an important role in resolving structural and technological problems, and by reducing non-recurring engineering costs associated with introducing new designs.

ELECTRON TRANSFER TECHNOLOGIES
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PRINCETON, NJ 08542
Phone: (609) 921-0070

Topic#: 93-024 ID#: 9310238
Office: MTO
Contract #: DAAH01-93-C-R263
PI: WILLIAM AYERS

Title: Point of Use Chlorine Gas Generator for Wafer Fabrication

Abstract: A point of use generator for chlorine gas production is proposed. The generator would provide ultrahigh purity chlorine which is necessary to enhance the growth rate and decrease the impurity level in silicon oxides for silicon device fabrication. The generator will also eliminate the need for environmentally unacceptable organochlorine compounds which are presently used for oxide growth enhancement. ANTICIPATED BENEFITS: The chlorine generator could provide very high purity gas to enhance silicon oxide growth. This would improve silicon device performance and stability.

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Topic#: 93-012 ID#: 9310077
Office: ESTO
Contract #: DAAH01-93-C-R264
PI: ROBERT ADAMS

Title: Indium Phosphide Material Growth for Microwave and Millimeter Wave Monolithic Integrated C ircuits

Abstract: The InP material system has been somewhat slow to develop for electrical devices commercially due to the general complexity of the associated alloys. The majority of work presently completed has been with Molecular Beam Epitaxy (MBE). While this technology offers many advantages in terms of growth, it suffers one major limitation related to InP--an inability to use phosphorous in the material compounds. This has resulted in very little work being done with InP as an epitaxial layer, preferring to use InO.52A10.48As instead. The desire to fabricate a high electron mobility transistor (HEMT) with this aluminum alloy has resulted in devices with less than spectacular performance. The fundamental difficulty has been the inability of the In0.52A10.48As to support the types of high voltages need for power applications. By using a growth technique with the capabilities for phosphorous compounds, Organometallic Chemical Vapor Deposition (OMCVD), a more comprehensive investigation can be made to identify the improvements to be gained by substituting InP as a large band gap material in place of In0.52A10.48As. ANTICIPATED BENEFITS: The benefits will be realized through lower cost components for use in various microwave and millimeter wave applications. The cost of MMIC's for automotive and communication applications will see dramatic reduction.

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Topic#: 93-011 ID#: 9310251
Office: DSO
Contract #: DAAH01-93-C-R256
PI: L. GANAPATHI

Title: Growth, Evaluation and Modeling of High Tc Superconducting Multilayer Structures

Abstract: Residual stress in thin-film materials resulting from thermal and chemical strains is a continuing problem in the synthesis of superconducting thin films. The problem exists not only in the superconducting layers, but also in the dielectric layer used as a buffer. Models that can analyze and predict the film stresses and accompanying mechanical failure are extremely useful as a starting point in the design of a multilayer circuit. The present program jointly proposed by Excel Superconductor, Inc. and North Carolina State University addresses this need. Computer modeling of typical multilayer structures containing superconducting thin films, dielectric layers and metal layers will model as well as provide feed back information to improve the model. The proposed research will enable us to determine the key factors responsible for the stresses developed in the processing of the films, mode of failure of the films by introduction of flaws and voids. This information will forecast the success of any particular HTS based thin-film device. In Phase I such a study will be carried out for TBCO/LaA103 and

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metal/TBCO/YSZ/Si systems, issues for Phase II will be identified for the use of the model for other systems. ANTICIPATED BENEFITS: When fully developed, the model could predict the mechanical performance of multilayer thin-film structures in a particular geometry. This will aid the selection of mechanically correct circuit designs suitable for any particular application like semiconductor interconnects, SQUIDS and hybrid electronic circuits.

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Topic#: 92-159 ID#: 9220110
Office: DSO
Contract #: DAAH01-93-C-R105
PI: GREGORY MATVIYENKO
Title: Wavelet Based Methods for Partial Differential Equations
Abstract: We propose to develop fast wavelet and adapted wave form methods for the solution of non-linear hyperbolic and elliptic partial differential equations. A generic example employed will be the PDES that arise in modeling and simulation of micro device fabrication. Current simulations of the various steps of microchip building involve large scale computations time. Wavelet and multiresolution tools are expected to be capable of accelerating some of these computations. We propose to adapt these methods to the fast computation of the optical profiles to be used as boundary conditions for the various PDES involved in the photo lithography process. These include computational solutions of nonlinear MAXWELL equations as well as reaction diffusion systems of equations. We expect that they will be handled more efficiently by appropriate wavelet tools. We have currently formed a team of the top experts in the USA in these related areas, in collaboration with top industrial research institutions including IBM, AMD and others. The methods to be developed are expected to assist U.S. industry and DoD labs. In particular the specific PDES considered will aid in the fabrication of 256 MB dram technology. ANTICIPATED BENEFITS: Fast algorithmic methodologies will enable us to reduce substantially the develo ment time for micro device fabrication, by allowing the manufacturer to interactively adjust his process to enhance line shape (LS) and critical dimension (CD) control of micro fabrications. More generally, the wavelet based numerical tools developed for this purpose will have a broad range of applicability for large scale computation in partial differential equations and simulations of similar industrial processes of interest to DoD.

FIBER MATERIALS, INC.
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Topic#: 92-157 ID#: 9220749
Office: DSO
Contract #: DAAH01-93-C-R106
PI: PAUL CHAYKA
Title: Creep Resistant Yttrium Aluminum Garnet (YAG) Fibers
Abstract: The primary objective of the proposed effort is to demonstrate a bench scale process capable of producing continuous, fine diameter, polycrystalline YAG (Yttrium Aluminum Garnet) fiber. Several published reports have documented the outstanding creep resistance of polycrystalline YAG at 1500-1600oC. The proposed effort will involve the use of a novel YAG precursor polymer which is suitable for fiber spinning. The chemistry behind this precursor, which was developed by Babcock & Wilcox Co. Fiber Materials, Inc., will develop spinning and sintering techniques with the objective of demonstrating continuous polycrystalline YAG filaments, with diameters < 15 microns. Characterization will include morphology of green and sintered fibers, crystal phase analyses and testing of tensile strength. ANTICIPATED BENEFITS: The fibers targeted by this proposal are badly needed in many DoD, DoE, and civilian applications requiring composite materials for high temperature, high stress environments. The fibers will permit energy savings, higher aircraft speeds and reduced emissions via higher operating temperatures for aircraft stationary turbine engines and automobile engines. Such a fiber will enhance the industrial competitiveness of the nation that develops it.

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Topic#: 93-009 ID#: 9310396
Office: DSO
Contract #: DAAH01-93-C-R266
PI: UDAY KASHALIKAR
Title: Flexible Manufacturing of MMC Electronic Packaging
Abstract: Foster-Miller proposes to integrate solid freedom fabrication technology and the pressure casting process to enable rapid prototyping of thermally efficient metal matrix composite electronic packages. A two-head SFF machine will be used to

simultaneously build a net-shape reinforcement preform and a ceramic mold for a customized electronic package. Accordingly, a casting "tree" consisting of a central feeder channel attached to multiple mold cavities will be built-up. This will be followed by pressurized infiltration with molten aluminum to produce 100 electronic packages with a 7 day turnaround time. SFF shape fabrication capabilities will be exploited to build through holes in the particulate preform for the package base. High thermal conductivity graphite fibers will be placed within these through holes. The resulting package base will have a high z-thermal conductivity and an in-plane CTE matching that of silicon or gallium arsenide. An aluminosilicate mold will be concurrently built-up using composite components to net-shape using similar ceramic molds. The Phase I effort will prove the feasibility of this integrated approach for rapid prototyping of MMC electronic packages. Reinforcement preform and casting tooling for a representative multichip package will be built at Soligen, and pressure infiltrated at Foster-Miller. Interfaces between the CIM, SFF and pressure casting steps will be designed during Phase I and developed during Phase II. E-Systems, an electronics systems integrator and Soligen, a SFF equipment developer, have agreed to be on the Foster-Miller team to demonstrate the above concept. ANTICIPATED BENEFITS: The Foster-Miller approach will enable 7-day turnaround time to procure 100 custom designed MMC electronic packages starting with a computer model. Commercial and industrial applications exist in systems using MMC components. Prototying of key MMC components will significantly shorten the period to develop a new products (e.g., aircraft, optics, palmtop computers) while reducing both product development and product manufacturing costs. Industrial applications exist to prototype hot, moving structural components for mining, hydroelectric and nuclear equipment.

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Topic#: 92-177 ID#: 9220338
Office: ESTO
Contract #: DAAH01-93-C-R052
PI: W. SCHROEDER

Title: Novel Computer Interface Using Eye Tracking

Abstract: The ideal computer interface should be usable: without "flat space," accessible from any posture; hands-free and hands-free portable; in any illumination or darkness, in any noise conditions, including those requiring hearing protection; with complete silence, if necessary. As a 3d virtual reality display an eye tracker interacting with a head-mounted display meets all these requirements. Information obtained by tracking the eye can be used by the computer as a pointing device (like a mouse). If both eyes are tracked and a display provided for each eye, pointing can be extended into the third dimension. Program development is planned to incorporate display technologies which will become available in the next 24 months. Phase I will specify and Phase II build and test a prototype of the device, which will make computer functionality available to support field, maintenance, and emergency work as well as extended usage for the everyday computer user. Applications for this technology beyond military and law enforcement include hands-free control, computer interfaces, and clinical tools for ophthalmologists and neurologists. The results of this program will have value to eye tracking technology in any case, and may prove an important factor in HMD design as well. ANTICIPATED BENEFITS: Many applications (military, law enforcement, emergency crews, etc.) need a truly portable computer link. Where panel and flat space are restricted, or where protective clothing limits manual dexterity, such as in naval or space equipment operation and maintenance, advanced computer technology is inaccessible, since tactile data entry is impossible, or the flat space for a keyboard and screen is "somewhere else." If the device works out to be relatively efficient and low cost, users in less restricted applications will be found.

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Topic#: 92-184 ID#: 9220358
Office: MICOM
Contract #: DAAH01-93-C-R132
PI: BRUCE GAMBLE

Title: Electric Field Up/Down Sensor

Abstract: Guidance sensors are an enabling technology for RPVS, UAVS as well as guided and autonomously guided munitions. Gyros have traditionally been used for these applications but tend to be complex and expensive. The atmospheric electric field is vertically oriented and sensors based on measuring the electric field gradient have been used in the past for guidance of aircraft. The Foster-Miller EFUDS (Electric Field Up/Down Sensor) is an electric field roll angle sensor based on a cylindrical field mill which is extremely simple and has good sensitivity. The measurement for a more general definition of orientation. Missiles can become highly charged due to the impaction of atmospheric particles and due to the charging action of the missile exhaust. The proposed system provides atmospheric electric field measurement capabilities to determine the roll angle in the presence of significant vehicle charging. Under the proposed program the impact of atmospheric variation in electric field will

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be reviewed with respect to system requirements. A cylindrical electric field sensor will be designed and significant features demonstrated in Phase I by towing the sensor behind an aircraft equipped and instrumented for such measurements. A preliminary design of an electric field sensor for guidance will be developed and key features will be verified in testing. ANTICIPATED BENEFITS: The successful design of a cylindrical electric field sensor will find application for a number of military and commercial uses requiring automatic control. In particular it offers a simple and cost effective means of guidance for RPVS, guided and autonomously guided munitions. The electric field sensors also can be used to measure lightening strike potential which is critical for air vehicle electronics protection and route planning.

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Topic#: 92-221 ID#: 9220357
Office: UWO
Contract #: DAAH01-93-C-R053
PI: ARNIS MANGOLDS

Title: LEMMINGS - A Swarming Approach to Shallow Water Mine Field Clearance

Abstract: A method is proposed which uses a swarm of inexpensive, limited intelligence expendable vehicles to discover and neutralize man made devices such as mines and obstacles. The vehicles referred to as LEMMINGS achieve a high rate of mission confidence using off the shelf components and some unique detection and control systems. The LEMMING Swarm is shown to require only 2 percent of the delivery volume and weight of 100 percent optimized distributed explosives. The swarming approach is inherently reliable due to the high level of redundancy. A pseudo-random search pattern has been developed which is position independent, thereby freeing the system of the single greatest control constraint of autonomous systems. An aggressive search mode minimizes the units required and simulations have shown consistently greater than 90 percent discovery and neutralization rates using threat densities and tactically useful lane widths. A unique detection system is also described which distinguishes man-made from natural objects. The system takes advantage of the unique environment and operating principle of the LEMMING Swarm. Proof of concept laboratory tests confirm detections is achievable without the need for extreme sophistication required by most systems. Neutralization is by detonation by a dedicated charge of 3 to 4 lbs of comp c4 contained within the vehicle. Detonation occurs at a present time interval. Other cargos such as beacons are optional. The overall LEMMING system architecture, simple design, and aggressive search pattern results in a countermeasure design which is as effective and of the same cost order as the threat mines. ANTICIPATED BENEFITS: The LEMMING sampling approach has a variety of applications whenever search and exploration is required. Similarly the feeler detection system is shown to be extremely sensitive and effective, and has a wide variety of potential applications wherever close proximity sensors are used. The Phase I effort will define, by test, the operational limits of all of the critical subsystems of the LEMMING Swarm.

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Topic#: 92-224 ID#: 9220469
Office: UWO
Contract #: DAAH01-93-C-R047
PI: MARK DRUY

Title: Neural Networks Determine Degree of Cure in High Rate Composite Fabrication Processes

Abstract: Foster-Miller, Inc., proposes to develop a neural network classification of infrared spectral information to determine degree of cure for the fiber placement of thermosets. The proposed Phase I program will advance the state-of-the-art in sensor based intelligent control by combining Foster-Miller's fiber optic FTIR process sensing with neural network classification technology from our subcontractor Neurodyne. The neural network will be trained to identify critical features in the infrared spectra of the resin and to calculate resin state properties. In Phase I we will begin training the neural network using our existing database of spectral information. Integration of the neural network hardware/software with a "look-down" resin state sensor would be performed in Phase II. This sensor/control system would then be combined with Foster-Miller's proven ultrasonically heated tape layer to demonstrate high speed placement of either thermoset or thermoplastic composites. The system and software would be sufficiently flexible to work with any other heating devices having similar characteristics (laser, microwave, hot gas) with minimal retraining. ANTICIPATED BENEFITS: Composite materials are attractive for many applications because of their high specific strength and stiffness, resistance to corrosion, low observable characteristics, etc. However, the labor intensive nature of manufacturing has inhibited widespread application of these materials. The advanced submarine technology and the composite armored vehicle programs will benefit from innovative process automation methods to ensure cost-effective manufacture of high-quality polymeric matrix composite structures.

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Topic#: 93-019 ID#: 9310314
Office: MICOM
Contract #: DAAH01-93-C-R267
PI: JEAN-LUC NOGUES
Title: Glass Host Dye Laser

Abstract: Currently, dye lasers use dyes that are dissolved in a solvent and then flowed through a cell or jet. Although this is a successful solution to achieve a working dye laser system with tunability over a broad spectrum, there are also significant limitations to the full realization of the potential of this medium. Primarily, liquid hosts adversely affect the thermodynamic, spectroscopic, and kinetic properties of the dye. In addition, disadvantages such as flammability, toxicity and leakage of carcinogens make these laser rods unsafe to handle. In order to create more sophisticated and highly manageable compact systems, a solid state dye laser is an attractive and beneficial concept to consider as a replacement for current liquid dye lasers. GELTECH, inc. proposes in this Phase I program, to develop prototype dye lasers by impregnation of a porous glass host made from their patented sol-gel process to demonstrate the feasibility of fabricating solid state dye lasers with improved efficiency and lower production costs. This approach can provide important advantages over the current sol-gel methods under development in other companies and universities. ANTICIPATED BENEFITS: The ability to have a tunable solid state dye laser that avoids the complex dye-flow systems currently used will enable flexible designs of convenient, storable, lightweight systems at a lower cost. This will impact such commercial applications such as therapeutic medicine, dermatology and urology. Benefits to military applications include remote sensing, laser blinders, and BW/CW devices.

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Topic#: 93-023 ID#: 9310057
Office: MTO
Contract #: DAAH01-93-C-R268
PI: VICTOR HONEIN
Title: Ultrasonic Thin Film Thickness Measurement

Abstract: The objective of this proposal is to develop an ultrasonic technique for the measurement of the thickness of thin films in an integrated circuit manufacturing environment. Our approach is to use ultrasound in the regime where the wavelength is comparable to that of light; that is in the frequency range of 1-10 GHz. In this range, it will be possible to measure the thickness of very thin and opaque films. Also, because the mechanical impedances of materials vary significantly more than their dielectric constants, we expect to be able to measure the individual thicknesses of layered thin films. An XY scan will be made to generate film thickness contour map of the wafer. ANTICIPATED BENEFITS: This project will demonstrate the feasibility of a technique which can be developed into a commercial thin/thick film thickness measurement system. Economical, quantitative, simple, inexpensive, and nonrestrictive measurements of the thickness of transparent and opaque, simple and multiple films, will have a great impact on the cost and quality control of thin film deposition in an integrated circuits manufacturing environment

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Topic#: 93-024 ID#: 9310041
Office: MTO
Contract #: DAAH01-93-C-R209
PI: DONALD GRANT
Title: Point-of-use Generation and Recycle of High Purity Wafer Cleaning Chemicals

Abstract: The cleaning chemicals presently used in the production of Ultra Large Scale Integrated (ULSI) circuits pose two major problems. The chemicals contain impurity levels that decrease the manufacturing yield of the circuits. In addition, they require extensive treatment for safe disposal. The process described in this proposal addresses regeneration to produce high purity chemicals. The process is applicable to the on-site, Point-of-Use regeneration of hydrofluoric acid (HF), hydrochloric acid (HCl) and ammonium hydroxide. Regeneration of these chemicals is accomplished using a combination of distillation and absorption. Distillation is used to separate the chemicals from process generated contaminants. Absorption into high purity deionized (DI) water is used to reconstitute the chemicals. The process is expected to produce chemicals with impurity levels well below those of commercially available chemicals. HF and HCl cannot be distilled directly from the spent chemical solutions as they form azeotropes with water. A proprietary method is employed to break the azeotrope without decreasing the purity of the recovered chemicals or creating a disposal problem. ANTICIPATED BENEFITS: Successful completion of this project is expected to yield a process which increases the manufacturing yield of ULSI circuits and reduces their manufacturing

cost. Use of the process will make the US semiconductor industry more competitive with foreign competition.

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Topic#: 92-158 ID#: 9220846
Office: DSO
Contract #: DAAH01-93-C-R077
PI: JOSEPH HALLORAN
Title: Surface Strengthening of Advanced Structural Ceramics
Abstract: Two techniques for producing ceramic laminate composite materials have demonstrated improved strength, reliability and fracture toughness. The two techniques include inducing surface compressive stresses and reinforcing them with transformation toughened materials or materials reinforced with second phase particles, whiskers or fibers. Another surface modification techniques utilizes thermoelastically tailored reinforced laminates that combine both increased toughening and surface compressive stresses into a ceramic composite structure. Laminate design techniques were also used to incorporate crack arresting layers near the surface to prevent surface flaws from growing to critical size. A major advantage of laminated-composite processing is that it provides the engineering flexibility to use innumerable material and property combinations that would be impossible with traditional methods involving thermal or chemical tempering. This concept also allows the use of non-equilibrium compositions for greater degree of stress profile variation. Maximizing the stress gradient by the introduction of a high-expansion material in the interior of the composite is impossible by conventional chemical tempering but is feasible by lamination. ANTICIPATED BENEFITS: Laminated ceramic composite designs can be used in a variety of structural applications but the thermoelastically tailored gradient designs have great potential for armor systems. Applying compressive layers on both the front and back face of ceramic armor can be achieved by laminated designs. Other military and commercial applications that can make effective use of laminated ceramic composite designs include high temperature engine components and cutting tool inserts. For these applications both gradient tailoring and crack arresting layer designs are appropriate.

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Topic#: 92-132 ID#: 9220478
Office: ASTO
Contract #: DAAH01-93-C-R084
PI: JOHN WEBSTER
Title: Low Cost, Non-Destructive Inspection of Aircraft Composite Parts
Abstract: Composite materials have failure modes unlike metals and alloys, suffering from delamination, debonding and cracking as well as deterioration from ambient exposure. In addition to failure in service, these materials also suffer from defects in manufacturing similar to those which occur under field stresses. Techniques which are employed for in-plant NDE are not suitable in the field, and in most cases require skilled interpretation of the data. A system which exploits the change in vibration characteristics, that is modal response, of composites when they have internal defects has the potential of providng a low cost, low skill NDE methodology which could be used in either a factory environment or in the field, on small or large structures. Relying on induced vibration by impigment of sonic or laser impulse, and the remote measurement of the amplitude of surface waves by means of doppler laser techniques, such a system could provide on site evaluation and also data storage for comparison of damage propagation in time. A rugged, compact system is envisioned, suitable for adverse field conditions where inspection after a battle mission is desired. The components of the technology has been demonstrated; integration into a demonstrable unit is the aim of the project. ANTICIPATED BENEFITS: A system which can store defect data and monitor defect would make NDE of aircraft more reliable. Being automatic in operation operator skill and interpretation of data is greatly reduced. Military and commercial aircraft would benefit from the ability to more frequently test parts considered more susceptible to defect formation and growth. The system could be applied to a wide range of other structures requiring periodic certification.

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Topic#: 93-014 ID#: 9310178
Office: ESTO
Contract #: DAAH01-93-C-R208
PI: DAVID BUCZEK
Title: Epoxy Flip Chips for MCMS
Abstract: Research and development of an epoxy flip chip technology is proposed that has several advantages over the C4 solder

bump flip chip. Firstly, it requires less capital investment and NRE costs. Secondly, the process itself is far less complicated. Thirdly, it may be more reliable than the solder bump process. The significant advantage of this epoxy flip chip technology is its affordability for production implementation for small companies. This should make MCM manufacturing available to a broader community. The feasibility and reliability of this process will be investigated by developing an application process and hardware for optimum epoxy bump geometries, evaluating commercially available robotic systems for final assembly, and testing a specially designed package that will include a silicon test chip and PGA. ANTICIPATED BENEFITS: After the successful development of an epoxy flip chip, potential applications would be a cost effective replacement for solder bump flip chips used in MCM. Other applications may include interconnects for back side illuminated detectors for primarily military applications.

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Topic#: 93-025 ID#: 9310023
Office: MTO
Contract #: DAAH01-93-C-R207
PI: STEVEN LIBRANDE

Title: Memory-based Graphics: A New Technology for Visual Interfaces and Interactive Visualization

Abstract: This project is based on a novel computer graphics technology for man/machine interfaces that relies on machine learning techniques, neural-like networks, and object recognition IU techniques. The key idea is to use a few "example" views of an object or person, to teach the computer to generate other views, under user control. With our technology we will develop an interactive (multimedia) interface that will enable the computer to communicate with the user with facial expressions and possibly synthesized speech. The technology advance is based on developments at M.I.T. of a new technique for learning from examples (the "HyperBF Network"), partly under DARPA and ONR funding, and to its specific application to computer graphics and animation (Poggio and Brunelli, Patent Application No. 7-819767 and Poggio and Librande, MIT Case No. 5831S). The technology is closely related to work at MIT in Professor Poggio's group on object recognition, which combines classical computer vision and networks for learning. ANTICIPATED BENEFITS: The main applications of the technology are to create new man/machine interfaces and enhance the images found in electronic documents, such as computer manuals and reference materials. Other applications that will benefit from this technology are virtual reality simulations, interactive multimedia and very-high compression teleconferencing.

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Topic#: 93-006 ID#: 9310340
Office: CSTO
Contract #: DAAH01-93-C-R205
PI: JAY KARMARKAR

Title: Scalable Accelerators and Interfaces for HPC System

Abstract: This feasibility effort is directed toward analyzing, designing, implementing, and demonstrating standard interfaces for the popular general purpose Intel 860 XR based scalable accelerator array board from several vendors (e.g., SKY Computers). For example, the widely used SKY embedded processor accelerator product family is scalable from 1 to 16 processors (1.28 Gflop) per VME 9U board, with up to 8 board per chassis (128 processors) and up to 8 such chassis in a system, providing over 100 Glops of computing capability at a cost of about $5 million, and power consumption of less than ten kilowatts. however, to effectively utilize this SUN host based cost-effective, real time embedded super-accelerator, it is essential that it be interfaced at a board level, to enable (hardware based) computational load balancing, with one of several alternate interface standards pertaining to: 1) super-computers/parallel disk arrays, 2) input sensors (e.g., multiple CCD cameras, multiple microphones), and 3) large (e.g., 2048 x 2048 pixels) SBGA format screens. Specific standard interfaces to be demonstrated are: 1) super computer HIPPI (ANSI x3T9.3), 2) multichannel (e.g., 3) RS170 (video), and 3) multiple SBGA (low cost displays). Early prototying experiments have demonstrated the feasibility of capturing incoming video with less than a 1/10 (i.e., 3-1/3 millisec) frame pipeline delay, thereby enabling "near real time" multiple video sensor processing. We anticipate a corresponding level of success in implementing above-mentioned scalable I/O interfaces. ANTICIPATED BENEFITS: The proposed interfaces will enable both military and commercial users to cost-effectively implement HPCC grade systems, both in the (multimedia) laboratory, as well as on real-time embedded applications on-board (e.g., air, surface, ground) moving platforms. This effort will eliminate the constraints faced by current users, in terms of the availability of diverse/multiple sensor input, high pixel count display output, and an HPCC compatible interface.

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Topic#: 93-013 ID#: 9310231
Office: ESTO
Contract #: DAAH01-93-C-R206
PI: JAY KARMARKAR
Title: Conformal Electronic Packaging

Abstract: DOD is currently exploring fabrication approaches, such as overlay interconnect (GE/TI) and flip chip on silicon (E-systems/Nchip). However, there is an opportunity to (1) implement and extend the capability of flip TAB (e.g., 2 mil pitch) technology to a generic multilayer/variable lead pitch reliable/compliant interconnect means to significantly reduce the typical cost of customized TAB tape and still take advantage of TAB tape testing/reworkability features; (2) configure a precision automated manufacturing workcell to concurrently handle dissimilar packaging technology, components (e.g., flip chip, flip TAB, bare chip), place them onto nonflat substrates (e.g., ceramic, 3D flexcircit); and (3) develop a generic, low cost 2D/3D, reworkable/repairable, compliant, TAB tape-like interconnect technique. The proposed program will demonstrate the feasibility of the novel interconnect concepts in Phase I, in terms of competitive performance/cost tradeoffs and process development and related application experiments concerning 3D based interconnect product opportunities. Then Phase II will develop proof-of-concept designs, implement prototype samples, and perform appropriate evaluation (electrical, thermal, mechanical) on test structures and test measurements, together with a processing equipment implementation plan. A key factor in the viability (e.g., cost, placement, accuracy, yield, reliability, reworkability) of the proposed low cost interconnect concept is usage of a precision, rapidly trainable vision-aided robotic assembly workcell to cost effectively populate the nonflat 3D substrate with the components, including automation of most, if not all, of the related process steps (e.g., solder reflow, electrical performance test, mechanical pull test, visual inspection). ANTICIPATED BENEFITS: The benefits of the proposed work are the development of a low cost generic/multipurpose reliable, compliant interconnect methodology that can accommodate a broad variety of interconnect requirements (e.g., between multiple 3D component layers, between components and 3D substrates). This fabrication methodology will lead to life cycle cost-effective means for interconnecting components to 3D substrates, using reworkable interconnect/attachment means, for military and commercial application, using precision, rapidly trainable vision-aided robotic 3D assembly workcells.

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Topic#: 93-005 ID#: 9310279
Office: CSTO
Contract #: DAAH01-93-C-R204
PI: YIM LEUNG
Title: Fault Tolerant High Speed Network Services

Abstract: The predominant concern of evolving high-speed network architectures is fault tolerance. High-speed networks will experience a variety of faults, such as link or node failures, excessive buffer overflow due to faulty flow and congestion control mechanisms, and partial failure of the switching fabric. The main goal of this research is to increase the availability of essential network services without compromising efficiency and cost. We propose a modular software fault tolerance toolkit, called charon, which can be applied at the application level to make network services tolerant to faults that are not handled at the hardware and operating systems levels. CHARON consists of a library of functions providing network services with heart beats, checkpointing and critical data recovering, and a mechanism consisting of four watch processing to monitor the heart beats of the network services and to recover crashed processes back to their last checkpoints. With the toolkit, network services can achieve fault tolerance with a minimum amount of changes to their source code. In this proposal, the functionality of each of the modules in CHARON will be studied. The application of the toolkit to a typical network service for improving fault tolerance will be demonstrated. ANTICIPATED BENEFITS: The anticipated result of this project is a toolkit and a mechanism to achieve fault tolerance in a wide range of network services. The toolkit outlined in this proposal will have a huge market potential for software and information systems vendors who are required to provide to users fault tolerance and high availability without excessive overhead.

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Topic#: 93-022 ID#: 9310059
Office: MTO
Contract #: DAAH01-93-C-R203
PI: JOHN WILLIFORD
Title: Use of Novel Momentum Transfer Technology and CFC Replacement Solvents for All-dry Photoresist and Wafer Cleaning

Abstract: A 6-month, Phase I Small Business Innovation research (SBIR) program is proposed to conduct proof-of-principle work on a novel process which uses momentum transfer mechanisms and liquid carbon dioxide for all-dry wafer cleaning. Under an earlier, Phase I project, the basic principle of momentum transfer has been demonstrated as effective, using high purity liquid carbon dioxide sprays accelerated by high pressure, dry, filtered air. Test coupons of polished silicon wafers were used, with particulate contamination and finger prints as materials to be removed. Continuation of this line of approach has been proposed in a Phase II application. Newer, proprietary approaches to momentum transfer are described in the present Phase I application, with refinements which should provide some potential improvements in purification and filtration demands, materials conservation and spray control. This approach appears to be adaptable to processing of VLSI materials and silicon substrates, and carries substantial advantages in comparison with supercritical fluid/US technologies for these applications. ANTICIPATED BENEFITS: Substitution of CO2 for CFC-113 in cleaning of electronic and mechanical parts will have on impact on the order of 19% of the billion kilograms of CFCs consumed on the global market (1986) estimate). These solvents are used domestically to produce about $5 billion in goods. Beneficial impacts on aerospace, biotechnology and electronic industries can come if being, effective and low cost solvents are identified.

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Topic#: 93-028 ID#: 9310192
Office: SSTO
Contract #: DAAH01-93-C-R171
PI: ERIC HOFFMAN

Title: Development of an Ultra Fast Range Sensor

Abstract: Range imaging is the measurement of the three-dimensional shape of an object as an array of 3-D distance values. While range imaging is a critical robotic sensing technology, existing methods are very slow; the best current devices still produce only a few tens of frames per second. We propose to develop an ultra fast range imaging system consisting of a scanning laser and a sensor array of photosensitive cells. The scanning laser sweeps a scene continuously with a moving light stripe, and each sensor cell of the array measures the distance by recording the time at which the incident light intensity peaks during each sweep. The novelty of this system is a VLSI-based computational sensor which exploits the inherent parallelism of this techniques by integrating photoreceptors, analog circuitry, and digital logic on a single CMOS die. The resulting system can produce 1000 range images per second, two orders of magnitude faster than current systems. Also, the system will be simple and compact since it does not require a separate computer for processing signals. Phase I of this project will develop a prototype design that will lead to commercial production of a highly advanced, high-speed range imager. ANTICIPATED BENEFITS: An ultra fast, 3D range imager will revolutionize the machine vision market, traditionally dominated by 2D techniques. Fast 3D vision and measurement systems will have endless applications, ranging from military and manufacturing to robotics, medicine, and textiles. Examples include: Whole shape measurement of a vehicle for radar reflectance simulation; design and inspection of manufactured parts; tele-existence via 3D images; and 3D imaging of the human body for reconstructive surgery, design of protective equipment, and the fashion industry.

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Topic#: 93-032 ID#: 9310064
Office: MSTO
Contract #: DAAH01-93-C-R172
PI: JAMES FITZGERALD

Title: "Synthetic-blubber" Compliant Coatings for Hydrodynamic-drag & Flow-noise Reduction

Abstract: Dolphin-Damp (a PVC gel) and Blubber-rubber (a polysiloxane rubber) are candidate "synthetic blubber" that can probably be formulated to closely match the dynamic mechanical complex shear compliance of live dolphin blubber. A program is proposed to remeasure dolphin blubber, using the modern Automated Dynamic Mechanical Modulometer, and blubber samples of opportunity obtained from the Whale Stranding Network. The Matched Shear Impedance Hypothesis advances the conjecture that dolphin blubber represents a "matched-load" to the turbulent boundary layer "shear-generator", thus delaying the onset of turbulence over the dolphin up to speeds of ~10 knots, or the equivalent Reynolds Number of Re~ 2 x 10-7. If suitable "synthetic blubbers" can be developed they could be expected to significantly reduce the hydrodynamic drag of an AUV and, thereby, increase its effective range. ANTICIPATED BENEFITS: Reduction of Towed Array Flow Noise; Reduction of Hydrodynamic Drag of AUV's; Increased Range of AUV's; Reduction of AUV Self-Noise

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Topic#: 93-016 ID#: 9310305
Office: LSO
Contract #: DAAH01-93-C-R173
PI: MICHAEL OWENS

Title: Method for Stimulating Hardware-in-the-loop in a Distributed Simulation Environment

Abstract: Simulations and their measurement involve careful experiment design, data gathering and data analysis. The final results obtained from the data analysis only characterize the system behavior for the range of input parameters covered. Although extrapolation can be used to obtain results for nearby parameter values, it is not possible to ask "what if" questions for arbitrary parameter values. By incorporating actual hardware components into the simulations, the range of input data can be greatly increased without having to modify the software that would otherwise simulate the hardware, and the data accuracy is greatly increased since the "live" component is used. The opportunity exists to increase the fidelity, flexibility, and validity of the research and development (R&D) in the Distributed interactive Simulation (DIS) environment through the use of an input/Output Controller for Stimulation (IOCS). Phase I will consist of requirements analysis, interface definition, architecture definition, and impact analysis for the IOCS. Phase II will consist of specification refinement, prototype design and implementation, and feasibility demonstrations. Phase III will consist of full production and commercialization. ANTICIPATED BENEFITS: Component interface definitions for DIS community use. Open system plug and play components. Automobile manufacturing development to add components to vehicle models.

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Topic#: 93-006 ID#: 9310045
Office: CSTO
Contract #: DAAH01-93-C-R175
PI: STEVEN KIM

Title: Parallel Processing Through Hybrid Photonic Inference Machines

Abstract: The goal of the proposed project is to develop a hybrid photonic inference machine to exploit the latent parallelism which often underlines inferential or deductive processes. The resulting technology will not only serve to accelerate logical programs, but also other inferential processes involving search. In fact, a basic theme of artificial intelligence is that search is the foundation of intelligence. Hence the proposed project has wide-ranging implications for artificial intelligence and its applications to practical systems. Moreover, the project is to such scope that a number of derivative applications are expected. For instance, a key aspect of the proposed work lies in parallel search through a society of cooperating modules. The resulting technology will therefore be useful for any distributed computational process, including parallel search through a large network of databases. ANTICIPATED BENEFITS: A high performance inference machine will have wide-ranging applications in any domain where high-level reasoning is paramount. Such applications occur in all fields of commerce, industry, and science, as demonstrated by previous artificial intelligence programs in these fields. Moreover, the aspect of the work on parallel search will be applicable to many disciplines and industries, from outline libraries to image processing, and from commercial customer lists to industrial data sets.

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Topic#: 93-020 ID#: 9310383
Office: MICOM
Contract #: DAAH01-93-C-R174
PI: J. MICHAEL FINLAN

Title: Increased Field of Regard Techniques for Staring IR Focal Plane Arrays

Abstract: A large field of regard (FOR) infrared (IR) focal plane array (FPA) is often desirable for applications such as missile guidance, spacebased surveillance, security surveillance, thermal imaging, remote sensing, and free-space optical communication receivers. Large FOR staring IR FPA's are presently very expensive and difficult to manufacture. A possible lower cost, easy-to-fabricate alternative is to scan the large FOR over a small IR detector array. Scanning approaches using binary optics with a microshifting mechanism, line scanners, and gimbaled wedge scanners have limitations in image quality and speed. We propose to provide a detailed analysis through a preliminary design and performance prediction of three different large search FOR IR FPA scanning concepts. Each concept has the potential to provide substantial performance improvements over previous techniques. The analyses will include parametric design studies of each scanning concept to determine a near-optimum design and the operating constraints for each concept. We will compare the designs for each concept to determine the best design for a given application. ANTICIPATED BENEFITS: The large search FOR IR FPA scanning concepts we propose to evaluate

have the potential to provide high quality images at high speed, small size, low power, and low cost. This will benefit applications such as missile guidance, space-based surveillance, security surveillance, thermal imaging, remote sensing, and free-space optical communication receivers.

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Topic#: 93-016 ID#: 9310303
Office: LSO
Contract #: DAAH01-93-C-R177
PI: STEPHEN MCDONALD

Title: Generic Operational Hardware Interface for Distributed Simulation Evaluation

Abstract: This project proposes the development and integration of a Hardware-in-the-Loop interface for Distributed interactive Simulation based systems. This will allow operational hardware/software systems to plug into DIS simulators. Using operational systems in Distributed Simulation increases the fidelity of the simulator and therefore the validity of tests using these joining simulator/operational systems. Mak Technologies has developed a basic Weapon Generation Tool (WGT) which allows software modules to be interchanged. This will be the basis for a tool that allows a weapon designer to create new systems that are a mix of operational hardware and a DIS simulator. Mak will also rely on its commercial DIS Toolkit (VR-Link) and a 1553 bus simulation. The goal of Phase I is to test the feasibility of mixing operational systems with DIS simulators. Phase II will generate a commercial quality system that allows non-programmers to build joint DIS/operational systems for use in Distributed Simulation experiments. ANTICIPATED BENEFITS: The commercial applications of this technology are: Automobile simulation tradeoff studies, aircraft simulation tradeoff studies, and video game generation.

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Topic#: 93-017 ID#: 9310304
Office: LSO
Contract #: DAAH01-93-C-R224
PI: WARREN KATZ

Title: Validated Engineering Models for Distributed Simulation Evaluation

Abstract: This project proposes the development and integration of two different software models for the same object; a high fidelity and a low fidelity model, which can be interchanged within the DARPA Weapon Generation Tool. Using validated engineering models in Distributed Simulation experiments provides users with a higher degree of realism in the cures that are produced by the simulation. Not all models must be at this level of fidelity, however. Great cost savings are realized when the model used is at a suitable level of fidelity for the task at hand. Mak Technologies has developed a basic Weapon Generation Tool (WGT) which allows software modules to be interchanged. This will be the basis for a tradeoff study between high and low fidelity software modules. Creare will develop two different fidelity models with standard interfaces to be compared within WGT. The goal of Phase I is to test the feasibility of swapping different fidelity models, and Phase II will begin the task of evaluation of different models within Distributed Simulation experiments. ANTICIPATED BENEFITS: The commercial applications of this technology are: automobile simulation tradeoff studies, aircraft simulation tradeoff studies, video game generation, and object-oriented Database management.

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Topic#: 92-130 ID#: 9220684
Office: ASTO
Contract #: DAAH01-93-C-R016
PI: JAMES LARSEN

Title: Multi-Media Network-Layer Protocols to Support Meteor Burst (MB) and Other Comnunication Media

Abstract: Under an existing IR&D program Meteor Communications Corporation (MCC) demonstrated that us standard 2400 BPS LPC-10 vocoded voice could be sent in near real time using a high performance meteor scatter system. This proposal investigates techniques to simultaneously improve the quality, recognizability, and intelligibility of the received voice and at the same time reduce number of bits per second required to send voice. We will investigate replacing the existing standard vocoder with experimental vocoders developed by the government. New modem techniques designed for enhancing performance of the vocoder will be investigated. These new vocoder technologies capable of operating at bit rates as low as 800 bps could allow high quality vocoded voice to be used on ordinary meteor scatter communications links. New link level protocols will be investigated to reduce delays. A novel adaptive protocol will be designed to reduce or increase the vocoder transmission rate

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to match enhancements or reductions in system capacity. An experiment will be conducted using the existing high performance link consisting of adaptive data rate protocol modem, high power amplifiers, and a multiple receiver phased array antenna system. ANTICIPATED BENEFITS: Incorporation of meteor scatter communication into conventional packet data communication infrastructure. Intelligent use of all available communication assets.

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Topic#: 93-001 ID#: 9310252
Office: ASTO
Contract #: DAAH01-93-C-R176
PI: JAMES LAWSON

Title: High-resolution Direction-Finding Systems for Long-range Position Location of HF/VHF Transmitters Using Meteor Scatter

Abstract: The objective of this program is to develop, analyze, and assess the performance of a system for locating the position of HF and VHF transmitters using energy from these transmitters that incidentally scatters from meteor trails. The proposal presented a candidate algorithm for meteor scatter position location (MSPL), which requires only angle of arrival data (both azimuth and elevation) for a number of scattered signals from several different receiving locations. The Phase I effort includes: evaluating this and other candidate algorithms for their capability to perform the MSPL mission; designing and evaluating the performance of systems for implementing these algorithms; selecting the best algorithm based on its estimated error performance and on the practicality of its implementation; detailing the system design, specifying the performance of its critical components, and determining the minimum antenna baseline; and estimating the system's error statistics as a function of basic measurement errors, emitters ERP, range, propagation variances, etc. MSPL systems require extremely accurate measurement of a signal's angle of arrival. Novel Difference-of-Time-of-Arrival Receivers for Direction Finding, developed by the proposing firm under U.S. Government sponsorship, have demonstrated angular resolution of 0.03 milliradian. These will be evaluated as key elements of the MSPL system. ANTICIPATED BENEFITS: MSPL systems can locate an emitter (hostile or friendly) when all normal communication channels are closed. MSPL systems can determine both the location and the axis of meteor trails, and may be configured to generate statistical data of these meteor events, a capability which may be of interest to atmospheric physicists and other in the scientific community.

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Topic#: 93-022 ID#: 9310272
Office: MTO
Contract #: DAAH01-93-C-R223
PI: STEVEN SHATAS

Title: All-dry Photoresist and Wafer Cleaning Techniques

Abstract: Recent advanced in advanced manufacturing vacuum-integrated cluster-tool processing have shown that many processing steps are amenable to single wafer processing (SWP). However, advanced in wafer cleaning and photoresist processing have not progressed to the point where they can be effectively integrated into the vacuum-integrated cluster-tool processor. This program outlines areas of basic research on all dry photoresist and wafer cleaning techniques which provide equal or better process performance to currently used liquid based processes. Successful development of all dry photoresist wafer cleaning techniques will have significant positive impact on the economics of vacuum-integrated cluster-tool processing and may provide a driving force for the increased use of vacuum-integrated cluster-tool processors in a manufacturing environment. ANTICIPATED BENEFITS: The successful development of all dry photoresist and wafer cleaning techniques will increase the driving force of the application of vacuum-integrated cluster tool processing. Additional benefits of all dry processing include reduced contamination and reductions in the use of ultrapure water and reduce supply and disposal of hazardous liquid chemicals.

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Topic#: 93-019 ID#: 9310240
Office: MICOM
Contract #: DAAH01-93-C-R226
PI: MARIO CAZECA

Title: Solid State Dye Laser

Abstract: Solid state dye lasers are of considerable importance for the laser industry in general. Currently, host materials present

several problems, like low stability, low damage threshold and dye degradation, which lead to a short operating life for these materials. Therefore, research with the purpose of identifying stable solid host materials that can be impregnated with laser dyes will be carried out. MTI is proposing to develop a class of guest-host materials with superior optical quality and high damage threshold to be used as solid state dye lasers. The proposed materials are based on sol-gel technology. The guest-host sampies prepared by this process will be cured at high temperature, which will ensure that the selected dye will be locked in the three-dimensional network of the glass matrix. The developed materials will be characterized for their optical properties and damage threshold. ANTICIPATED BENEFITS: The results of this research will be new materials for solid state dye lasers. Consequently, small portable dye lasers will become possible. These lasers are of considerable importance for commercial applications in the field of optical data processing and communications.

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Topic#: 93-026 ID#: 9310333
Office: SSTO
Contract #: DAAH01-93-C-R227
PI: SUE TOLEDO

Title: A Free-text Database Retrieval System Incorporating the Semantic Network Wordnet

Abstract: Searches of free text databases depend on the keywords used in the request for information. If keywords are extracted from the user's query and no use is made of synonyms, relevant data in the database may be overlooked. The same can be the case if class-subclass, and part-whole information is ignored. The semantic network WordNet that has been developed by Princeton University encodes a very rich store of semantic information concerning relationships between words that are used constantly in any language understanding. These include subordinate-superordinate and part-whole information, as well as refinements to them, restrictions of relationships to appropriate contexts and mappings between words of different categories (nouns, adjectives, verbs). It is envisioned that uses of the relationships encoded in WordNet can allow the computer to make deductions allowing it to determine that many texts are relevant to the needs that a user expressed in quite different terms. Netrologic proposes to develop a system to categorize articles based on concepts encoded in WordNet, and to create a free text database interface to search documents categorized in this way. ANTICIPATED BENEFITS: The efficient determination of all documents in a database relevant to a user's needs is becoming increasingly important, as larger and larger free text databases are coming in line. A system that contains an embedded semantic network can be an invaluable aid to everyone in both government and the general public who will be making extensive uses of large databases.

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Topic#: 93-031 ID#: 9310245
Office: MSTO
Contract #: DAAH01-93-C-R228
PI: DONALD SOFGE

Title: An Intelligent Scalable Control Architecture for Distributed Nonlinear Systems

Abstract: This project will develop and implement a learning controller architecture for control of complex distributed nonlinear systems with multiple localized equipment controllers and a variety of sensor feedback. The fundamental philosophy of this approach is to optimize control at a local level through the use of neural networks and optimal control techniques such as dynamic programming, and to utilize the longer term planning and optimization capabilities of optimal control to coordinate the local controllers and achieve global system optimization. This intelligent control architecture will be implemented on an advanced scalable distributed control platform developed by Honeywell, the Advanced Equipment Controller System. This work will build upon numerous previous research and development projects in intelligent and distributed control, both by NeuroDyne Inc. and Honeywell, under funding from DARPA, NSF, NAVY, NASA, Air Force, internal R&D, and others. This will result in a flexible, intelligent, scalable, modular, adaptive distributed control platform which may be easily applied to a wide variety of systems and processes. ANTICIPATED BENEFITS: The potential commercial applications of this technology are as wide as the applications of industrial control itself. A proven intelligent control architecture will be implemented on an advanced Honeywell scalable controller hardware platform to provide self-configuring, self-optimizing process control which is easily adaptable to a wide variety of industrial processes in aerospace, microelectronics fabrication, chemical process control, and numerous other areas.

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Topic#: 93-013 ID#: 9310401
Office: ESTO
Contract #: DAAH01-93-C-R225
PI: LAMAR BULLOCK
Title: Conformal High Density Interconnects
Abstract: Miniaturization of electronic packaging creates new product opportunities and enhances the performance of existing products. New fabrication approaches that allow more densely packaged electronics are needed. High density interconnects that conform to the shape of a product would take advantage of the naturally available space in smart weaponry, spacecraft, personal communication devices and handheld computers. Omicron will characterize the materials and processes necessary to produce a conformal high density interconnect. Moldable plastic materials will be explored as interconnect substrates. Metalization and dielectric inner layer materials and will be defined. Methods for production of vias will be developed. Imaging techniques applicable to three dimensional circuitry such as laser direct write and conforming mask technology will be defined. Minimum conductor width/spacing/thickness and imaging speeds will be determined. ANTICIPATED BENEFITS: Conformal high density interconnect technology will allow more densely packaged electronics in handheld computers, smart weaponry, personal communication devices, and space craft. Reduced payloads and increased system performance will be seen in military and space applications. New market opportunities for handheld computers, sensors, and medical devices will be created.

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Phone: (205) 880-8207
Topic#: 93-002 ID#: 9310359
Office: ASTO
Contract #: DAAH01-93-C-R247
PI: ARTHUR WERKHEISER
Title: Aerospace System Applications of Micromachine Technologies
Abstract: Aerospace systems undergo environmental stressing which ultimately limit their useful life. Empirical rules and constant inspection are required for commercial and military aircraft because real-time data are not known for the high-cost systems. This effort proposes imbedded microelectronic and microelectromechanical devices to constantly monitor aerospace systems and a life-cycle analysis of the system's reliability and readiness. The imbedded devices will be located throughout the aerospace system at strategic locations to provide the analysis program with information not only on electrical systems but also provide information on vibration, acceleration, temperature, pressure, and stress. The Phase I effort will identify suitable candidate applications, provide a framework for the life-cycle analysis program, and construct one or more microelectromechanical sensors on chip suitable for aerospace systems applications. Other candidate microelectromechanical devices will be identified for use in a life-cycle predictive system/sensor network. The sensors will include on-chip electronics to reduce the central computer's computational burden. Phase II efforts will provide a suite of micro-sensors integrated into a life-cycle predictive system suitable for aerospace systems and for commercial applications. ANTICIPATED BENEFITS: The life-cycle predictive system with imbedded sensors for real-time analysis will enable military and commercial aircraft to anticipate future failure or imminent failure of structures/systems. This will in turn prevent certain classes of air-borne catastrophes and save lives. The technology may be applied to other high-cost structures that exist in stressed conditions.

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Topic#: 93-020 ID#: 9310256
Office: MICOM
Contract #: DAAH01-93-C-R250
PI: ROBERT FISCHER
Title: Increased Field of Regard Techniques for Staring Infrared Focal Plane Arrays
Abstract: Infrared missile seekers using staring IR FPA sensors are finally becoming a reality. The inherent field of view of the overall system is often quite small, and a significantly larger total field of regard is imperative. Use of a wide field of regard mechanical gimbal is often used to cover a large search volume. Improved methods are proposed to scan or slew over wide fields of regard. Further, image smear presents a problem during wide field of regard sluing, and improved methods are proposed for stabilizing the image during the frame capture time. This SBIR will address both of these separate yet related issues by developing innovative optical methods for creating a large field of regard as well as developing a means for stabilizing the image motion during the time of image capture. ANTICIPATED BENEFITS: The methods developed in this SBIR could have significant benefits in virtually all commercial arenas where wide fields of regard need to be covered with high resolution. Examples include machine vision and automated inspection, security cameras, aerial photography for many remote sensing

applications, and other examples extend to the many commercial video needs where image stabilization is of value.

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Topic#: 93-021 ID#: 9310254
Office: MTO
Contract #: DAAH01-93-C-R249
PI: ROBERT KALMAN
Title: Packaging of Optoelectronic Multichip Modules
Abstract: Future systems will require high-speed optical interconnection of computers in networks and of devices with in a computer at the backplane level. These optical interconnections will require hybrid packaging of optical, electronic, and optoelectronic devices in optoelectronic multichip modules (OEMCMs). Major challenges in OEMCMs involve achieving optical interconnection of various devices within the OEMCM, and specifically achieving low coupling losses through mode matching and very precise positioning of devices. We propose development of OEMCMs based on the use of a silicon substrate for mounting of all devices, and offer these innovations: (1) use of planar tapered waveguides to achieve mode matching complex connectivity (e.g., optical signal splitting and combining) between devices within the OEMCM, (2) novel structures for combining planar tapered waveguides with semiconductor devices, and (3) advanced structures and techniques for mounting the various devices to the substrate. We will examine performance, manufacturing issues, and process compatibility of all components. The proposed innovations will allow the development of OEMCMs with passive positioning of all devices, which are manufacturable at low cost with high yield and reliability. These OEMCMs will be applicable to a wide variety of communications and computing systems. ANTICIPATED BENEFITS: The proposed innovations will allow the development of OEMCMs with passive positioning of all devices, which are manufacturable at low cost with high yield and reliability. These OEMCMs will be applicable to a wide variety of communications and computing systems.

PHOTON RESEARCH ASSOC., INC.
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Topic#: 93-017 ID#: 9310393
Office: LSO
Conract #: DAAH01-93-C-R248
PI: DAVID ANDING
Title: Method for Incorporating High-Fidelity Engineering Models Into Distributed Simulations
Abstract: The proposed work will develop a concept for incorporating high-fidelity system performance models into SIMNET-like simulators for sensors. The models will include end-to-end modeling of sensor to virtual battlefield radiometric input and the transmission of sensor responses over a network. Sensor response modeling will include subsystem models of optics or antenna, transducer, signal and data processors, data transmission, and coupling to the platform controlling sensor position, line-of-sight direction and motion. The required sensor performance models, constrained to operate on workstation-class computers, provide real-time sensor responses. The concept consists of a system capable of building a robust Sensor Response Simulation (SRS) applicable to any desired sensor, but unconstrained with regard to execution time; plus algorithm development procedures to yield real time transformation algorithms between the virtual battlefield state and the sensor response. Phase I will prove concept usefulness and validity by delivering an SRS system prototype with a fully developed real-time sensor response model for the strategic DSP and another system representative of a tactical class sensor. Phase II deliverables will include the SRS system with integrated DIS or SIMNET interoperability and documented procedures for adding a simulator for any sensor. ANTICIPATED BENEFITS: The workstation-class system for building robust end-to-end sensor response simulations will have widespread application to sensor engineering, material acquisition, and C3 training of sensor effectiveness. All government and commercial enterprises involved in sensor system engineering, for any application from defense to environmental monitoring, will benefit from this technology.

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Phone: (503) 682-2806
Topic#: 93-007 ID#: 9310083
Office: CSTO
Contract #: DAAH01-93-C-R246
PI: STEVEN NAKAMOTO
Title: A Machine-Independent High Performance Fortran Compilation System Target for the Intel Paragon Parallel Computer System
Abstract: Parallel computers have been widely available for several years but have yet to fulfill their promise despite the potential

for greater scalability and lower cost/performance. While interest in parallel computing systems remains high, widespread proliferation and acceptance of these systems has not occurred. The basic problem facing MPP users is a lack of portable and scalable programming systems, portable and scalable libraries, and a portable programming language. Recently, the High Performance Fortran data-parallel language has been developed by a consortium of industries, academic institutions and national laboratories. The bases for HPF include the ANSI/ISO standard Fortran 90 (1) as well as Fortran D (2). Syracuse University has developed a portable Fortran 90D prototype compiler and library. The Portland Group, Inc. has developed a commercially accepted optimizing, vectorizing Fortran 77 compiler, pgF77, for many Intel i860TM parallel systems. Early analysis shows good potential for creating an effective machine-independent HPF compiler for various MIMD parallel systems. This proposal will research and specify the requirements for a commercial machine-independent HPF compilation system using these two components, Fortran 90D and pgF77 as a basis. This HPF compilation system will initially be targeted for the intel Paragon. ANTICIPATED BENEFITS: An effective machine-independent HPF compiler with libraries. A robust, commercially available HPF compilation system for multiple parallel MIMD systems with the Intel Paragon being the initial target system.

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Topic#: 93-007 ID#: 9310096
Office: CSTO
Contract #: DAAH01-93-C-R255
PI: STEVEN NAKAMOTO

Title: A Machine-independent High Performance Fortran Compilation System Targeted for Networked Superscalar SPARC Systems

Abstract: Parallel computers have been available for several years but have yet to fulfill their promise despite the potential for greater scalability and lower cost/performance. While interest in parallel computing systems remains high, widespread proliferation of these systems has not occurred. The basic problem facing MPP users is lack of portable and scalable programming systems and libraries and portable programming language. Recently, the High Performance Fortran data-parallel language has been developed by a consortium of industries, academic institutions and national laboratories. The bases for HPF include the ANSI/ISO standard Fortran 90 (1) as well as Fortran D (2). Syracuse University has developed a portable Fortran 90D prototype compiler and library. The Portland Group has developed commercially accepted optimizing, vectorizing Fortran 77 compiler for Intel i860TM and SuperScalar Sparc parallel systems. Early analysis shows good potential MIMD parallel systems. This proposal will research and specify the requirements for a commercial machine-independent HPF compilation systems using these two components, Fortran 90D and pgFortran 77 as a basis. This HPF compilation system will be targeted to a network of SuperScalar Sparc workstations, specifically Sun SS-10s. ANTICIPATED BENEFITS: An effective machine-independent HPF compiler with libraries. A robust, commercially available HPF compilation system for multiple MIMD parallel systems with a network of Sun SS-10s being the initial target system.

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Topic#: 93-004 ID#: 9310249
Office: ASTO
Contract #: DAAH01-93-C-R265
PI: DONALD HERMAN

Title: High-efficiency CCD-based Regulator

Abstract: Q-Dot, Inc. proposes an innovative "no-drop" regulator (NDR) for low-voltage micro-power sensor systems. Based upon charge-coupled devices (CCDs), it provides high efficiency with less noise and at a low cost. designed for battery or solar-cell systems, it has zero-volt input-to-output differential for highly efficient "no-drop" regulation. A 3 V NDR requires only two 1.5 V batteries, decreasing its size and weight. A linear regulator's inherent diode drop requires three batteries. A switch-mode regulator includes an isolation diode, reducing its efficiency and limiting the maximum input voltage to a diode drop above the desired output voltage. The NDR provides isolation without a diode, allowing operation with higher voltages. CCDs also produce lower noise and ripple than conventional switch-mode regulators. Voltage multiplication is possible with the NDR if desired. Thus, more efficient, lower-noise operation over a wider voltage range than competing regulators is possible. The NDR feasibility will be assessed during Phase I. Prototypes will be fabricated and tested during Phase II. Broad DARPA and commercial applications will drive Phase III production of this innovative regulator concept. ANTICIPATED BENEFITS: High-efficiency regulation will extend the life of any battery-operated system. Examples include hand-held telecommunication, GPS, and imaging systems; notebook and laptop computers; cellular phones and mobile radios; remote sensors and data collection systems; pagers, beepers, and other remote signalling devices.

QUEST INTEGRATED, INC.
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Topic#: 93-030 ID#: 9310237
Office: MSTO
Contract #: DAAH01-93-C-R258
PI: PAUL HWANG

Title: Designs of Undersea Bubble Cloud Targets Using Collective Oscillations to Produce Low Frequency Underwater Sound

Abstract: Bubbles within a cloud can undergo collective oscillations and produce large acoustic emissions at low frequencies (20 to 2 kHz). Using the collective oscillation properties, relatively small targets can be developed for underwater acoustics research and other applications. This proposal presents three designs to produce and contain bubble clouds in a fixed geometry for the purpose of producing low-cost, high-target-strength acoustic scatterers for sonar calibration and decoy design. The first design is a cylindrical container made of an acoustically transparent material. A propeller will be used to disperse the bubbles into a spatially homogeneous distribution. Compressed air or chemical foaming agents can be used as the air supply to produce microbubbles from an underwater bubbler. The second design uses agar gel to stabilize air bubbles grown from decompression of the supersaturated gel. The third design uses polymer additives to suspend and stabilize bubbles injected at the time of target production. The void fraction and bubble size can be adjusted by mass flow rate, size of aerator and degree of supersaturation, depending on the design selected. The acoustic resonance frequency can be tuned by varying the size and number of the injected bubbles (therefore, the void fraction) and the size of the containers. ANTICIPATED BENEFITS: This research effort will lead to the successful development of low-cost bubble cloud targets for commercial applications in sonar calibration, undersea beaconing, environmental simulation, and designs of decoys and countermeasures. The products will benefit researchers as well as manufacturers in the field of ocean acoustics and defense industries conducting underwater acoustics research.

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Topic#: 93-032 ID#: 9310092
Office: MSTO
Contract #: DAAH01-93-C-R257
PI: H.T. PETER LIU

Title: Development of Synthetic Dolphin Blubber Compliant Coatings

Abstract: QUEST Integrated, Inc. (formerly Flow Research) proposes to develop and fabricate compliant coatings synthesizing dolphin skin/blubber for use on underwater vehicles to achieve drag and flow noise reduction. Guided by the theory of the hydrodynamic response of viscoelastic materials, the design of the compliant coatings will be aided by using a computer code combining finite element techniques, viscoelastic material theory, and available acoustic data from studies on live dolphins. Following the current trend of compliant coating research, we will consider three different coatings all with a thin but strong exterior layer that serves as the protective skin for the interior layers, which have the desired viscoelastic properties but are weak in mechanical strength against wear and tear. Three types of interior layer(s) will be evaluated: an isotropic layer, multiple (progressively softer) isotropic layers, and multiple fiber-reinforced layers. These compliant coatings will be fabricated, and their viscoelastic properties will be measured at the material laboratory of the Naval Surface Weapons Center. One of the coatings will be selected to be installed on a "self-propelled" slender body for laboratory testing in a towing tank as a means for assessing the practicality and robustness of the coating. A novel visualization technique will be used to determine the potential of the coating for drag reduction. For measuring the flow noise, a microphone will be installed inside the body. ANTICIPATED BENEFITS: This development will improve the performance of underwater and surface vehicles, for military and civilian applications; lead to increases in the speed and range of the vehicles, enhancing their mobility and reducing their vulnerability and operational cost; and result in flow noise reduction, and thus decreased detectability. The coatings may also be applied to propellers/impellers to increase thrust output. Commercial applications include use as coatings on ship hulls and as liners in various pipelines.

RESEARCH INTERNATIONAL, INC.
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Phone: (612) 371-0848

Topic#: 93-010 ID#: 9310233
Office: DSO
Contract #: DAAH01-93-C-R259
PI: BOONE OWENS

Title: Battery on a Chip Feasibility/Applications

Abstract: The long term objective of this program is to provide a high performance, thin-film microbattery that will serve as a highly reliable, rugged, miniature power source amenable to providing on-chip power for microelectronic devices. A solid state lithium-based technology will be adapted to this product. In Phase I, the project will further investigate candidate

microbattery applications, develop appropriate application-specific designs for thin-film solid-state batter/microcircuit modules and fabricate and test prototype devices to demonstrate concept feasibility. ANTICIPATED BENEFITS: Development of a new generation of microelectronic devices is necessary to provide leadership in world-wide technology. Commercial applications will include new, improved sensors for pollution monitoring and control systems, high performance chips for information management in consumer products, and more reliable and effective medical devices such as implantable drug pumps and cardiac defibrillators.

SARCOS RESEARCH CORP.
390 WAKARA WAY, SUITE 44
SALT LAKE CITY, UT 84108
Phone: (801) 581-0155
Topic#: 93-002 ID#: 9310122
Office: ASTO
Contract #: DAAH01-93-C-R216
PI: IAN MCCAMMON
Title: Micro Sensor Network for Aerospace Applications
Abstract: In military and commercial aircraft, airframe health is central to operating safety, maintenance costs, and aircraft availability. While thorough inspections provide the best means of assessing airframe health, they are expensive, time consuming, and can inflict new damage to the aircraft. Other methods of estimating airframe health, such as flight logs and service records, must be very conservative to account for variations in operational loading and corrosion. Recently, researchers have been investigating embeddable sensors for real-time sensing of airframe strains, but their high cost and their requirement for composite structures render these systems impractical for near-term implementation. In this proposal, Sarcos Research Corporation (SRC) outlines a development effort for an airframe health monitoring system based on micro machined strain sensors. The system will monitor real-time fatigue and strain in both metallic and non-metallic structures. By using an innovative digital sensor developed by SRC previously, this system will measure the absolute strain at each sensing point, without the drift associated with conventional strain gages. Phase I will develop a system design that will include monolithic signal processing and mutliplexing to improve performance and greatly reduce wiring and weight requirements. Phase II will implement a prototype system of distributed strain sensors, and Phase III will focus on commercial development of the system. ANTICIPATED BENEFITS: The robust and versatile health monitoring system proposed will have immediate application in the military and commercial aircraft industry. Other areas where structural performance is critical, such as in naval vessels, space structures, bridges, and buildings, will also benefit from this development.

SCIENTIFIC RESEARCH ASSOC., INC.
50 NYE ROAD, P.O. BOX 1058
GLASTONBURY, CT 06033
Phone: (203) 659-0333
Topic#: 93-008 ID#: 9310039
Office: DSO
Contract #: DAAH01-93-C-R215
PI: TONY CHAN
Title: A High-speed Tunable Multi-Wavelength Thermal Imager
Abstract: An innovative imaging technique is proposed for surface/wafer temperature measurement in a chemical vapor deposition (CVD) reactor. Limitations in measuring absolute, as well as relative temperature in a CVD reactor, limit the ability to utilize intelligent processing of material, including feedback or forward control of the CVD process. Comparison of the ratios of spectral radiance at several wavelengths to the theoretical ratios of intensity derived from Planck's radiation law allows the evaluation of absolute temperature independent of the absolute photo flux. Current multiple-wavelength pyrometry, even though able to overcome the wavelength dependency of emissivity, is handicapped by its inability to measure radiance at multiple wavelengths simultaneously. The proposed technique uses an acousto-optic tunable filter (AOTF) to rapidly obtain multiple spectral radiance information. Under Phase I, the proposed temperature measuring system will be developed and optimized to improve the scanning rate, bandpass and signal-to-noise ratio. Under Phase II, the developed temperature measuring system will be applied in conjunction with an intelligent process control technique to a material process, such as the growth of InP or GaAs in a CVD reactor. ANTICIPATED BENEFITS: The system (thermal sensor and process control) developed would have a significant commercial impact on increasing quality control of electronic, photonic, aerospace and high strength materials.

SENSORS UNLIMITED, INC.
3490 U.S. ROUTE 1, BLDG 8
PRINCETON, NJ 08540
Phone: (609) 520-0610
Topic#: 93-008 ID#: 9310310
Office: DSO
Contract #: DAAH01-93-C-R272
PI: MARSHALL COHEN

Title: Compact NIR Spectral Radiometer for CVD Non-contact Temperature Measurements
Abstract: We propose to develop an instrument for feedback loop control of chemical vapor deposition (CVD) processes. The research will include both process modeling and hardware development. At present, quantitative temperature measurement using optical emission is possible only if the thermal emissivity is known. The innovation will be the incorporation of novel emissivity models into a compact NIR spectral radiometer. The core of the spectrometer will be a dielectric stack "wedge" filter used with an InGaAs photodiode array. Our goal will be a measurement accuracy of 1oC at 1 Hz repetition rates during both low and high temperature (50-1000oC) CVD. Feasibility will be demonstrated during Phase I by utilizing the modeling with a grating-based InGaAs photodiode array spectrometer featuring no moving parts and rapid spectral measurement will be developed. This spectrometer will be used to verify the technology on actual CVD systems. The modeling activity will be performed with the collaboration of the New Jersey Institute of Technology as a benefit of their DARPA ManTech program "Multi-Wavelength Imaging Pyrometry for Semiconductor Process Monitoring and Control (F33615-92-C-5817). ANTICIPATED BENEFITS: The RF and gaseous environments in CVD reactors makes it difficult to accurately measure temperature electronically (thermocouples, thermistors, etc.). The ability to accurately and rapidly measure temperatures from outside the chamber will allow process control techniques to be used to greatly improve manufacturing efficiencies.

SI DIAMOND TECHNOLOGY, INC.
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Topic#: 93-015 ID#: 9310406
Office: ESTO
Contract #: DAAH01-93-C-R217
PI: HOWARD SCHMIDT

Title: Affordable High-field Spacers for Field Emitter Displays
Abstract: Field Emitter Displays (FEDs) represent the "leap frog" technology which can rebuild America's dominance in the information display industry. This represents simultaneously a critical technology area for Defense and a multi-billion dollar market opportunity. Basic technology feasibility for FEDs has been amply demonstrated already. The remaining questions are those of engineering and economics. Improvements are needed most in spacer technology, low energy phosphors, and cathodes. LETI proved that current phosphors are at least adequate, if not ideal, for the time being; and the MCC/SI diamond Team has recently developed a major breakthrough in diamond cold cathode fabrication and performance. This leaves high field spacer technology prominently exposed on the critical path to FED commercialization. We propose herein to demonstrate an affordable, reliable approach to fabricating and installing high performance spacers for Field Emitter Displays. Failure mechanisms in current spacers are fairly well understood, and presumably one can improve spacer performance by any number of brute force routes. We shall confine the Phase I Program, however, to identifying economical solutions that support rapid market entry, consistent quality and high volume production. Phase II will focus on setting up pilot scale production based upon the Phase I results. ANTICIPATED BENEFITS: Improved spacers will help enable a new generation of flat panel display technology, Field Emitter Displays. FEDs will serve advanced computer, telecommunications and entertainment applications in the consumer market, as well as avionics, CCCI and general hi-rel applications in Defense.

SONETECH CORP.
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Phone: (603) 472-2055

Topic#: 93-027 ID#: 9310226
Office: SSTO
Contract #: DAAH01-93-C-R273
PI: HARVEY WOODSUM

Title: Voice Authentication Monitoring Investigations
Abstract: The proposed research addresses the problem of online authentication of a talkers identity using techniques borrowed from text-independent speaker identification. The proposed investigation will develop a basis for a Phase II, real-time system effort suitable for operational testing. The proposed algorithms build upon a number of prior developments by Sonetech and Lockheed-Sanders Inc., a proposed subcontractor, in optimizing feature sets and classification algorithms for real-world speaker identification systems. ANTICIPATED BENEFITS: Authentication system suitable for use with high value STU III users, and for commercial and security voice authentication applications.

SPACE POWER, INC.
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SAN JOSE, CA 95134

Topic#: 93-004 ID#: 9310236
Office: ASTO
Contract #: DAAH01-93-C-R270

Phone: (408) 434-9500 PI: SEE-POK WONG
Title: Low Cost, High Efficiency Power Conditioning Unit for Unattended Ground Sensors
Abstract: SPI has a unique combination of experience in power electronics that will benefit the development of the PCU for Internetted Unattended Ground Sensors (IUGS). We specialize in the development of highly reliable, efficient, compact systems. We have extensive experience in the development of space-use DC-DC converter systems and PCUs for space electric propulsion systems. In dealing with low cost, high volume manufacturing, we have successfully developed and manufactured a converter/limiter for thermoelectric generator. This product outperformed our competitors with its technical performance as well as its low cost. We propose to use our experience to develop a PCU for IUGS that will cost less than $100 for a commercial grade product. This product will be reliable, maintenance free, and output short-circuit protected. If necessary, a power optimization circuit will be incorporated to maximize the power drawn from the sources. In Phase I, we will work with the DARPA technical monitor and other technical staff to study and define the requirements of the PCU. A full scale breadboard unit will be built in Phase I to demonstrate the feasibility of the technical approach as well as to provide basis for manufacturing cost estimation. ANTICIPATED BENEFITS: The PCU developed in this program will meet the exact requirements of the DARPA IUGS and therefore will directly benefit the development of the IUGS. Since the power requirement of the sensors and the characteristics of the power sources are very similar to other remote sensors for military or commercial uses, we project a broad range of applications and high volume use of the low cost PCU.

TRITON SYSTEMS, INC. Topic#: 93-019 ID#: 9310262
186 CEDAR HILL STREET Office: MICOM
MARLBOROUGH, MA 01752 Contract #: DAAH01-93-C-R269
Phone: (508) 460-9493 PI: ROSS HAGHIGHAT
Title: A New Sol-gel Host Material for Improved Solid Dye Lasers
Abstract: Triton Systems, Inc., proposes an innovative exploratory research program to fabricate and test, by lasing, a new and unique sol-gel host material for improved dye lasers, called "SupraGel." These materials will allow for the development of dye lasers of improved efficiency, longer lifetime, higher mechanical integrity, improved machineability, and improved optical quality. Specifically, the resulting material will address the drawbacks associated with competing systems such as thermal lensing, lasing efficiency, laser life, process complexity and user-friendliness and demonstrate the potentials of this unique new system by fabricating ruggedized transmissive host laser medium that will have minimal optical defects, high mechanical strength, and minimal dye-host interaction; all compared to Ormosil sol-gel-polymer media. In Phase I of this program, we will produce and characterize several candidate SupraGel host materials, several dye-host samples, and we will lase one or more of these laser dye-host materials. In Phase II, we plan to optimize the process and study the structure-property relationship of the proposed systems. ANTICIPATED BENEFITS: The proposed program will develop a tunable visible light laser, without the problems of fluid flow management, potential toxicity, and potential flammability that are associated with fluid dye lasers. The successful Phase I program will allow the development of a test dye laser in Phase II that can be adapted to military, medical, R&D and communication applications.

X-RAY OPTICAL SYSTEMS, INC. Topic#: 93-023 ID#: 9310362
9 PHYSICS, 1400 WASHINGTON AVENUE Office: MTO
ALBANY, NY 12222 Contract #: DAAH01-93-C-R271
Phone: (518) 442-5208 PI: MICHAEL VARTANIAN
Title: In-situ Microfocus X-ray Photoelectron Spectroscopy Of Ultra Large Scale Integrated (ULSI) Wafers
Abstract: Although x-ray photoelectron spectroscopy (CPS) is an extremely valuable analytical tool for material characterization in semiconductor manufacturing, its use is limited by the currently available spatial resolution. The economical fabrication of ULSI circuits depends on in-situ non-destructive inspection tools with increasingly stringent spatial resolution and sensitivity requirements. This project will investigate using tapered x-ray capillary optics to decrease the area sampled during XPS by an order of magnitude without a decrease in sensitivity. X-Ray Optical Systems, Inc. proposes to combine tapered glass optics techniques developed for higher energy x-ray energies with a recently demonstrated ability to achieve high transmission efficiency with the appropriate energy range (1-1.5 keV) for XPS. The researchers and collaborators are leading figures in the development of capillary x-ray optics and cluster tool technology. ANTICIPATED BENEFITS: A successful outcome would lead to better in-situ real-time process control of ultra large scale integrated circuits. This would provide improved ULSI circuit performance and improved manufacturing yields.

APTEK, INC.
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Topic#: 93-006 ID#: 93-P1-147
Office: DNA
Contract #: DNA001-93-C-0165
PI: Brett A. Lewis

Title: Eulerian Non-Reflecting Boundary for Structure-Bubble Interaction Involving Near Field Convention Explosions

Abstract: Current computer analysis of bubble-submerged structure interaction, due to conventional weapons, is extremely resource intensive. Therefore, it is very difficult to replace full scale live fire testing of submerged structures with scale testing of submerged structures and computer analysis. The goal of this effort is to develop an accurate and efficient non-reflecting boundary for eulerian hydrodynamics analysis programs. This boundary will make it possible for the computer analysis effort to concentrate on the important areas such as the structure. This eulerian non-reflecting boundary will be derived from a Lagrangian non-reflecting boundary, specifically doubly asyzoptotic approximation.

BERKELEY RESEARCH ASSOC., INC.
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Topic#: 93-015 ID#: 93-P1-024
Office: DNA
Contract #: DNA001-93-C-0142
PI: James L. Geary, Jr.

Title: A Plasma Opening Switch Model for Power Flow Electrical Circuit Design

Abstract: A new Plasma Opening Switch (POS) model is proposed for implementation into an electrical circuit computer code. The unique approach described in this proposal incorporates a segmented sheath model into the existing magnetohydrodynamic (MHD) codeprism developed by Berkeley Research Associates, Inc. The version proposed for Phase I includes 1) two-dimensional mhd motion of the bulk plasma; 2) relativistic, equilibrium electron motion in the sheath; 3) dynamic ion motion in the sheath; and 4) solutions to Gauss's law and Ampere's law in the sheath. This formulation is carefully chosen to balance inclusion of those basic physical features believed present in long conduction time opening switches with computational efficiency. The information required for the POS-circuit model will be the initial plasma state, the geometry, and circuit parameters for the generator and the load. There are no other free parameters. A single fob model encompasses both the conduction and opening phases rather than using separate models for each phase. In Phase I, the fob model will be embedded in a circuit code which will be comprised of RLC circuit and transmission line modules to represent the generator and load. Results from this model will be compared to existing experiments such a DPMI at the Physics International Company, ace 4 at Maxwell Laboratories, and Hawk at NRL.

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Topic#: 93-007 ID#: 93-P1-192
Office: DNA
Contract #: DNA001-93-C-0132
PI: Dr. Jolanta I. Soos

Title: Nuclear Hardening and Survivability of Acousto-optics

Abstract: With the very wide range of applications of acousto-optic signal processing and optical communication in nuclear warfare arms, the need exists to evaluate optical signal processors components in both real and simulated nuclear environments. Also the use of acousto-optic devices for a commercial space applications is very promising due to its high speed, low power consumption and light weight. In Phase I of this program brimrose proposes to extensively evaluate the performance of acousto-optic devices presently used in the optical computers, early warning radar systems, laser communication systems, etc. before and after subjection to EM radiation. Phase I program will define some of the critical parameters of acousto-optic materials which under go a change under an EM radiation. Knowing those parameters the A-0 devices materials can be radiation hardened before an A-0 device is fabricated. Based upon Phase I results in Phase II of this program brimrose will design and fabricate a radiation resistent acousto-optic device using radiation harden acousto-optic materials. The goal of this program is to study and employ radiation hardening techniques to stabilize and improve performance of A-0 devices exposed to 1500 KRad of gamma radiation.

DEFENSE GROUP, INC.
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Topic#: 93-013 ID#: 93-P1-006
Office: DNA
Contract #: DNA001-93-C-0167

Phone: (310) 394-8599 PI: Russ R. Laher
Title: Artificial Neural Network Tracking of Targets in Nuclear Backgrounds
Abstract: We will adapt and improve an innovative moving-target detection and tracking approach, based on Artificial Neural Network (ANN) processing techniques, for application to the tracking of boost-phase missile targets in the presence of infrared clutter due to high-altitude nuclear explosions (banes). Our research will use time-sequenced simulated infrared images of bane backgrounds with moving targets. These images will be provided by Photon Research Associates (PRA) using the SDIO/NRL Strategic Scene Generation Model (SSGM). Algorithm training and performance testing will be done for representative levels of target signal-to-noise ratio, and nuclear clutter level, and results will be presented in the form of probability of detection versus probability of false alarm curves. The tracking algorithm will include standard nuclear-clutter suppression techniques as a pre-processing step.

ENERGY COMPRESSION RESEARCH CORP. Topic#: 93-014 ID#: 93-P1-078
6355 NANCY RIDGE DRIVE Office: DNA
SAN DIEGO, CA 92121 Contract #: DNA001-93-C-0212
Phone: (619) 450-6612 PI: Dr. Ian McIntyre
Title: Solid State High Power Generators for Radiation Testing of Systems
Abstract: A new approach to ultra-high power pulsed technology, applicable to radiation test simulation, is presented. It is based on the development of one terawatt (1 tW) pulsed power generator modules. These modules can be charged in air and use only solid state components. They are switched by laser-activated closing switches. The resulting modules are extremely compact and, utilizing a single stage of switching and a double transit of transmission line capacitors, are highly efficient, over 60%. The units are sized to drive megavolt range loads for hard x-ray generation this program will be directed at designing and testing all aspects of this technical approach and in designing and building reduced scale prototype units.

FEMTOSCAN CORP. Topic#: 93-012 ID#: 93-P1-046
1834 WEST 4700 SOUTH Office: DNA
SALT LAKE CITY, UT 84118 Contract #: DNA001-93-C-0214
Phone: (801) 966-2266 PI: Neil S. Arnold
Title: Miniature, Handheld Chemical Warfare Material Detection System for Treaty Verification Using Gas Chromatography/Ion Mobility Spectrometry
Abstract: Accurate chemical analysis at potential sites of Chemical Warfare (CW) agent manufacture, storage or use is of great value for determination of CW treaty violations and for verification of destruction or removal of CW agent systems. Recent developments in hand-held gas chromatography/ion mobility spectrometry (GC/IMS) for direct air monitoring have illustrated the potential of this technique for rapid (<1 min), sensitive (<.0006 Mg/m3 using CW stimulant materials), analyses of CW agents. The proposed work seeks to produce a system capable of rapid detection, identification and monitoring of a broad range of CW agents, precursor chemicals, decomposition products and incineration by-products at the levels required for treaty verification, stockpile surveillance and demilitarization. This technical approach combines a novel air sampling inlet with a short capillary GC column and a civilian version of the successful CAM (Chemical Agent Monitor) type ins device. In view of its greatly increased specificity, dynamic range and linearity, GC/IMS represents a quantum leap in performance over ins systems while preserving hand-portability, simplicity, ruggedness and maintainability as well as high sensitivity. GC/IMS offers the only combined chromatography/spectroscopy approach which can be readily incorporated into a hand-portable device. Phase I objectives are to: (i) compile literature data on cw agent precursors, decomposition products and incineration by-products; (2) carry out feasibility tests on representative chemicals; (3) investigate the feasibility of surface contamination detection; (4) develop specifications for prototype systems to be developed under Phase II.

FLUID PHYSICS IND. Topic#: 93-014 ID#: 93-P1-126
4265 MANCHESTER AVE. Office: DNA
ENCINITAS, CA 92024 Contract #: DNA001-93-C-0207
Phone: (619) 436-2848 PI: Richard M. Traci
Title: "Electrothermal Gun Interior Ballistics Model Assessment"
Abstract: The Electro-Thermal-Combustion (ETC) gun concept was developed as an advanced technique for hypervelocity gun

systems which augments the electrical energy input of the original ET gun by using a reactive working fluid. This however has compromised the ability to control the interior ballistic processed principal advantage of the ET gun concept. In the ETC gun, the gas generation rate is one step removed (by the plasma jet mixing and reaction rates) from the electrical energy deposition rate thus making the method less controllable than the ET gun. If the dynamics of plasma jet penetration and mixing were well understood, then in principal, the correct jet dynamics for optimum projectile acceleration could be created by tailoring the electrical pulse shape, among other things. However, detailed knowledge of plasma jet behavior at gun operating conditions is currently lacking. Although it is generally understood that jet penetration and mixing play an important role in determining ballistic performance, it is not clear how to improve jet characteristics to optimize performance. Ongoing research programs are directed at improving this promising approach. The SBIR program proposed herein is designed to compliment these programs by utilizing a recently developed fluid dynamic model capability to analyze the important two phase turbulent jet mixing processes crucial to the successful operation of the ETC concept. It is proposed to contribute to the understanding of ETC gun interior ballistics and, in particular, of the jet dynamics and mixing process, by utilizing the turbulent two phase reactive fluid dynamics capability which resides in the magic/bison fluid systems codes. The program will specifically address jet dynamics including droplet formation and evolution mechanisms which, it is believed, control plasma jet evolution and the resulting gas generation rate. The computational analysis of these mechanisms will help provide the clue to improved ETC gun performance.

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Topic#: 93-007 ID#: 93-P1-104
Office: DNA
Contract #: DNA001-93-C-0128
PI: James F. Spratt

Title: Input Protection Circuits for Cryogenic Silicon ICs

Abstract: A major element of the threat to space LWIR surveillance systems from exoatmospheric nuclear weapons effects is that of EMP/SGREMP produced electrical overstress (EOS) on read out electronics used in conjunction with focal plane arrays in imaging systems. Use of existing technology for protecting such circuits from EOS would be problematical because of the cryogenic temperatures at which they operate. Imagers using Hg Cd Te detectors usually operate at temperatures from 77K to 30-40K, while those using Si:x detectors operate as low as 10K. Full Circle Research, Inc (FCR) proposes to conduct an SBIR program to study the effect of low temperatures on input protection devices and input protection technology for cryogenic silicon IC. Where appropriate, FCR will exploit device phenomena unaffected by freezeout (e.g. tunnel breakdown in place of conventional avalanche breakdown. Phase I of this effort will carry out the design of cryogenic IPDS through the conceptual design review stage, while Phase II will design, build, and demonstrate a breakboard version of a cryogenic input protection circuit using these new devices.

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RADFORD, VA 24141
Phone: (703) 639-4019

Topic#: 93-020 ID#: 93-P1-026
Office: DNA
Contract #: DNA001-93-C-0213
PI: DR. Edward J. Yadlowsky

Title: Development of a Two Reference Beam Holographic Technique to Measure the Density Distribution in a Plasma Opening Switch

Abstract: A good model for predicting the conduction and opening characteristics of plasma opening switches is required if switches currently in use are to be scaled up to the current and voltage ratings required by the family of threat simulator. Empirical verification of the numerous models which have evolved around different conduction processes have met with limited success because switch characteristics depend weakly on the switch parameters varied and it is difficult to vary only one switch parameter at a time. Measurements of the plasma distribution within the switch, with good spatial resolution, would reveal how the plasma responds to the self generated forces in the switch. Dominant physical processes, inferred from these measurements, could then be used to construct realistic models of the switch. Hy-Tech proposes to use a two reference beam technique to record a double pulse holographic interferogram of the plasma cross-section using a short pulse laser to "freeze" the plasma motion. The phase of the reconstructed interferogram would be analyzed using phase shifted interferometric techniques to obtain spatially resolved measurements of the plasma density. A phase shift resolution of 1 x 10-4 fringes with a spatial resolution of O.OLCM is anticipated. These density measurements should indicate whether plasma accretion associated with axial snow plow motion occurs, how magnetic forces distort the plasma profile, and whether evidence exists for the formation of a magnetically

insulated vacuum gap.

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Phone: (508) 777-4247
Topic#: 93-007
Office: DNA
Contract #: DNA001-93-C-0139
PI: Wade Krull, PhD
ID#: 93-P1-080
Title: Ultra-low Pinhole Simox
Abstract: A program is proposed to evaluate the impact of channeling of oxygen on buried oxide integrity in simox material. Buried oxide pinhole density and crystallographic orientation related patterns in buried oxide pinhole maps will be explained depending upon the implant angle. The method based on the electrolytic plating of copper will be used to obtain the maps of pinholes. This work will improve knowledge of channeling of oxygen in <100> silicon and its impact on simox properties. Application of the results will lead directly to the improved integrity and reliability of buried oxide and excellent uniformity of thin film layers at the same time. Another implication would be better repeatability and consistency of the material obtained in the manufacturing environment. Development of the ultra-low pinhole simox with the above improvements in properties and better consistency in manufacturing will provide advantages to all simox customers and may also enlarge the simox market.

INNOVATIVE MECHANICS, INC.
265 COE ROAD
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Phone: (708) 887-9020
Topic#: 93-017
Office: DNA
Contract #: DNA001-93-C-0175
PI: Dr. Andres Peekna
ID#: 93-P1-029
Title: Development of Rock Stress Gage
Abstract: The concept combines inherent lack of significant sensitivity to unwanted stress components with practicality of coupling to rock with little or no grout. Building on a foundation of thorough theoretical analysis and demonstration of manufacturing feasibility based on previous work, the objective is to verify key aspects in the laboratory. This will include verification of lack of cross-axis sensitivity, survival and absence of spurious signals in controlled impact loading, and static measurement of gage registration in rock blocks under well-defined conditions in a triaxial test chamber.

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Phone: (505) 268-8982
Topic#: 93-001
Office: DNA
Contract #: DNA001-93-C-0176
PI: Robert A. Ballance, Ph.D.
ID#: 93-P1-033
Title: Design Platform for Weapons Effects Computational Codes
Abstract: In this proposal we offer to develop for the Defense Duclear Agency a software design framework that can be used by all of DNA's contract organizations for their own individually tailored DNA computational software--existing or developmental. This framework makes use of newly developed object-oriented design aides to enable users to build their own code for use on the newest workstations and Massively Parallel Processing (MPP) architectures without resorting to rewriting the software for use on these multiple architectures. That is, the same user source code could be ported to a Sun, Cray, or Connection machine with only another implementation of the framework required. This software design framework represents such a significant advance in scientific computing that no less than two National Laboratories (Sandia and Los Alamos) are investing considerably in this technology for the newest MPP architectures. We will focus our design platform specifically at the kinds of large-scale code that DNA contractors are using today; code like NIKE2D/3D, DYNA2D/3D, CMLE, CM, TRANAL, and NASTRAN. In Phase I we will demonstrate our approach with just two of these codes, NIKE2D (implicit code) and DYNA2D (explicit code).

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Topic#: 93-005
Office: DNA
Contract #: DNA001-93-C-0174
PI: Frank W. Davies
ID#: 93-P1-085
Title: A High Temporal Resolution In-material Gauge for the Measurement of Non-reactive Shocks and Detonation Waves in

38

Explosives
Abstract: A feasibility study is proposed for an encapsulated, high temporal resolution, broad range piezoelectric polymer stress gauge to measure shock-to-detonation transitions in explosives and propellants. These measurements are key to the development of effective "growth to detonation" models which are a necessary element in the assessment of the vulnerability and/or development of tactical systems including theater missiles and air defense systems. The gauge will use the ISL PVDF sensor as its basic element. The study will examine the characteristics of both candidate encapsulation materials and of PVDF itself at high stress. The configuration of the active element and electrode leads will be optimized and encapsulation materials and fabrication techniques will be defined that ensure effective operation and yet maximize the temporal resolution of the gauge package. The feasibility of the encapsulated gauge design will be demonstrated at high pressures in both inert and reactive materials. This gauge is unique in its ability to measure both the low amplitude shock and the detonation in a shock-to-detonation process and in its ability to release the Chapman Jouget conditions in many explosives.

MISSION RESEARCH CORP.
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Topic#: 93-013 ID#: 93-P1-092
Office: DNA
Contract #: DNA001-93-C-0172
PI: Brian R. Milner

Title: Analysis, Mitigation, and Testing Capability for Antenna Tracking in Disturbed Propagation Environments
Abstract: Antenna tracking systems for satellite communications links are subject to performance degradation in the presence of signal propagation disturbances. The extent of this degradation and the corresponding sensitivity to tracking system configurations and design parameters has not been quantified. System specifications and receiver designs developed in the absence of this information may result in unexpected and undesirable reduction or loss of communication performance. Furthermore, mitigated antenna tracking analysis, design, and verification are not straightforward matters. Presently there are no tools available to adequately assess the potential degradation levels and validate mitigation designs for operation in the presence of propagation disturbances. The objective of this effort will be to develop the capabilities for performance analysis, mitigation evaluation, and hardware validation. Detailed computer simulations of disturbed signals, together with software implementations of receiver signal processing and antenna tracking algorithms, will be employed to evaluate the performance of representative antenna tracking configurations. Once the performance issues have been quantified, the feasibility of candidate hardware test configurations will be evaluated. A key result of this effort will be the determination of the necessary channel model characteristics which must be represented to achieve a sound analysis and hardware test validation of antenna tracking systems.

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Topic#: 93-013 ID#: 93-P1-121
Office: DNA
Contract #: DNA001-93-C-0168
PI: L. J. Nickisch

Title: Finite Difference-Time Domain Propagation in Randomly Structured Ionization
Abstract: The accurate characterization of RF signal structure due to propagation through the nuclear disturbed ionosphere is essential for the performance assessment of, and mitigation development for, communications and radar systems. Tractable solutions to the governing equations have been found for many important propagation regimes by applying a series of standard approximations. Where no suitable approximations exist, the standard approximations are speculatively pushed into the invalid regime. Examples include the application of parabolic equation results to HF propagation (contradicting the assumption that the wavelength is small relative to the field correlation length) and the extrapolation in DNA's SATCOM and space radar RWC signal specifications to propagation along the geomagnetic field (likely violating Markov and "thick media" assumptions). The questions remain: how far can the standard approximations be pushed? Do the approximations break down gracefully? These questions can now be explored using the Finite Difference - Time Domain (FDTD) method. We have recently shown that the FDTD method can be applied to propagation in the ionospheric plasma and we now possess the only algorithm capable of addressing the above issues. Our Phase I effort will encompass developing the necessary codes, performing initial calculations, and defining the requirements for a full Phase II analysis.

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Topic#: 93-015 ID#: 93-P1-179
Office: DNA
Contract #: DNA001-93-C-0170
PI: John J. Watrous
Title: An Improved Plasma Opening Switch for DECADE
Abstract: Current attempts to use the Plasma Opening Switch (POS) for decade have not yet been entirely successful due to the apparent inability of the switch to open efficiently to a high-impedance load. Research directed toward improving the performance of the POS in the long-conduction time regime has been frustrated by the inability of computational tools to operate in the parameter regimes of interest to the experimentalists. The design of an improved opening switch for decade requires the use of a computational tool that can operate in these high-density and long timescale regimes. The only tool currently available which not only can operate in these regimes efficiently, but which also can explore nontrivial geometries, is the 2D MHD code MACH2. We will use MACH2 to analyze long-conduction time POS experiments, starting with the tapered cathode experiments conducted on the HAWK facility at the Naval Research Laboratory. We will study the feasibility of using and extending MACH2's HALL-MHD model for treating vacuum electron flow. These Phase I efforts will lead to a Phase II research program whose goal is to produce an improved plasma opening switch for decade.

PHYSITRON, INC.
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Topic#: 93-019 ID#: 93-P1-145
Office: DNA
Contract #: DNA001-93-C-0166
PI: David B. O'Hara
Title: Silicon Aerogel Debris Shields for Nuclear Weapon Effect X-ray Simulators
Abstract: X-ray nuclear weapon effect simulators use a PLDSMDS to produce an intense pulse of soft x-rays to determine their effects on optical and electronic materials. Debris emitted from these PLDSMDS complicates the interpretation of the effects of x-rays unless a debris shield is used. These debris shields must be thin enough to give low x-ray attenuation but robust enough to survive the impact of high velocity debris. These competing debris shield requirements limit the fluency on a target and the SRED which can be exposed. Even the lowest density and lowest atomic number conventional debris shield material as significantly attenuates the x-ray fluency. Physitron, Inc. proposes to use the lowest density solid material known as a debris shield. Silicon aerogel is a dry gelled form of Si(OH)4 with density as low 35 0.005 Gm/cm3 even with this low density, the aerogel is strong enough to be rigid. And to support considerable weight. Its combination of strength, extremely low density, and low atomic number makes it an ideal debris shield material. Physitron proposes to fabricate and test silicon aerogel debris shields for nuclear weapon simulators. In addition to use 8s an x-ray debris shield, this material could be used as a replacement for current diamond x-ray windows for low energy x-ray instruments.

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Topic#: 93-020 ID#: 93-P1-042
Office: DNA
Contract #: DNA001-93-C-0217
PI: Dr. Niansheng Qi
Title: Space and Time Resolved Measurements of Current and Electron Density Profiles Around High Current Z-pinches
Abstract: It is proposed to use a sensitive laser probe beam to measure, via beam refraction and faraday rotation, the plasma densities and magnetic fields (hence current profiles) around high current z-pinches. During Phase I, a simple version of the proposed laser metrology tool, using many components already available at SRL, will be validated by measuring the -0.5 Ma currents (100-300 t magnetic fields) and 1020 cm-3 electron densities around a Dense Plasma Focus (DPF) z-pinch, which is also already available at SRL. Although this DPF pinch operates at relatively low current, the magnetic fields and electron densities are within a factor of 2-3 of those expected in higher current simulators such as phoenix or decade. The Phase I validation tests will therefore provide reliable design criteria for a higher powered version of the laser metrology tool for Phase II. During Phase II, such an upgraded version of the laser tool will be built and tested on high current z-pinch sources such as phoenix or decade.

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Topic#: 93-010 ID#: 93-P1-002
Office: DNA
Contract #: DNA001-93-C-0190
PI: James P. Jaworski

Title: Genetically-evolved Digital Networks for Target Planning

Abstract: Target planning is one of the most significant technical challenges to developing a tactical or strategic war plan. The requirement is to analyze considerable amounts of data concerning the enemy, common and allied force situation and provide results in a form useful for quality decision making in a short period of time. Due to the complexities of mission planning, these systems will become more autonomous, with a man-in-the-loop to override, correct errors and to monitor performance. Short timelines and semi-autonomous operations pose a classic challenge to the artificial intelligence community to explore new and innovative adaptive information processing approaches that minimize reliance on heuristic or ad hoc techniques. Networks of dynamically programmable logic modules (DPLM networks) appear promising in such areas as pattern recognition and classification, signal processing, and robotics. One specific requirement is to develop new parallel processing techniques to support target planning applications. The objective of the proposed Phase I project is to demonstrate that a genetic algorithm can be used to evolve DPLM network software to support complex target planning applications.

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Topic#: 93-001 ID#: 93-507
Office: BMDO
Contract #: DASG60-93-C-0068
PI: Kenneth Crandall
Title: High Current CW Superconducting RFQ Linac
Abstract: The effectiveness of the Neutral Particle Beam (NPB) missile defense system depends on the successful acceleration of high brightness H ion beams at high currents with Continuous Wave (CW) operation. Present baseline designs for these powerful Linac systems include one or more stages of beam combination (funneling) into later stages of the Linac to overcome the current limitations of the initial Linac stage, the Radio Frequency Quadrupole (RFQ). However, several SDIO system design contractors have suggested that this limitation can be overcome with the use of a Superconducting RFQ (SCRFQ) designed specifically for high current. Initial results of a superconducting niobium structure at Argonne National Laboratory (ANL) suggest that the current limit in such a device might be an order of magnitude greater than conventional RFQ designs. The successful development of such a high current SCRFQ will not only offer significant advantages for NPB systems, but for medical and industrial applications requiring high current CW ion beams as well. The objective of the proposed Phase I effort will be to establish the practical design criteria for a high current CW SCRFQ and develop the design tools and computer simulation codes necessary to complete a prototype structure conceptual design. This study will be performed in collaboration with the group of superconducting niobium Linac structure experts at ANL in the Engineering Physics Group. The results will form a solid foundation for the Phase II final design, fabrication and testing of a high current SCRFQ prototype.

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Topic#: 93-003 ID#: 93-251
Office: BMDO
Contract #: DASG60-93-C-0081
PI: Peter Kanam, PHD
Title: Totally Monolithic GaAs/HgCdTe Focal Plane Arrays
Abstract: We propose to develop a totally integrated monolithic GaAs/HgCdTe FPAs on GaAs substrated. The innovative features are: 1. The detector is fabricated directly on the GaAs multiplexer substrate, with the monolithic metal interconnect instead of standard indium bumps allowing array sizes up to 1024x1024 with high frame rates. 2. The focal planes will incorporate an on-chip low power massively parallel, high speed ADC enabling off focal plane data readout with high immunity to off chip noise sources. 3. The focal plane will contain high speed drivers for reduced output line count coming off focal plane, reducing complexity and heat load. Readout and ADC designs are described. Detailed fabrication steps to achieve monolithic GaAs/HgCdTe FPAs are shown. During Phase I preliminary test cells will be designed and layed out, and experiments will be conducted to grown HgCdTe on GaAs substrates. During Phase II, a totally integrated 4x4 element monolithic GaAs/HgCdTe FPA will be fabricated, tested and the design of a 1024x1024 element array will be initiated.

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Topic#: 93-003 ID: 93-494
Office: BMDO
Contract #: DASG60-93-C-0104
PI: Howard Bailey
Title: Silicon Technology Retina Image Processor
Abstract: Currently, Focal Plane Array (FPA) sensor technology requires reading out and digitizing each and every pixel on the FPA. In addition, all data processing is performed on a off-sensor digital computer. To utilize human-like vision in large-staring-array high-speed acquisition and tracking sensors, unmanned vehicles, or in commercial machine vision, it will be necessary to develop a retina-like electronic image processor. Otherwise the data processing task will be too large, costly and impractical for current digital processing technology. This is a proposal for the design, fabrication and test of a Complementary Metal Oxide Semiconductor (CMOS) chip which will process image information "like" a human retina. The chip is called the Silicon Technology for a Retina Image Processor (STRIP). Unlike other electronic retina designs which attempt to mimic a biological structure using silicon, the strip focuses on the advantages of silicon in achieving retina-like performance. In addition, the strip concept can be used with visible or infrared detectors, extending vision applications beyond the spectral range of human vision. The main focus of the Phase I program is the design, fabrication and testing of the strip image processor chip for military scenarios, using existing 1.5 um CMOS design rules. The focus of Phase II will be the fabrication and testing of a full scale strip design including detector, readout, correction and image processor chips.

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Topic#: 93-014
Office: BMDO
Contract #: F33615-93-C-1293
PI: Douglas Gordon

ID#: 93-625

Title: Low Valent Titanium Source Reagents for MOCVD of Titanium Nitride

Abstract: Titanium Nitride (TIN) is rapidly becoming an important material as a barrier layer in VLSI drams, as an antireflection coating and as a "glue" layer between noble metals and silicon dioxide in both memory and logic devices. Typically, thin films of TIN are deposited by physical vapor deposition methods, but as device feature sizes shrink to ULSI dimensions, Chemical Vapor Deposition (CVD) will be the manufacturing of choice. Unfortunately, no TIN precursors exist that allow CVD of TIN at low temperatures without contamination problems. In Phase I ATM proposes to determine the feasibility of designing novel source reagents that allow the deposition of TIN by CVD temperatures below 500 C degree without chlorine, carbon or particulate contamination. The identification of such precursors would for their demonstration in full scale memory device fabrication in Phase II and their rapid commercialization in Phase III.

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Topic#: 93-014
Office: BMDO
Contract #: F33615-93-C-2332
PI: Gregory Stauf, PHD

ID#: 93-607

Title: Ferroelectric Capacitors for Pulse Power Electronics

Abstract: High-density energy storage and fast discharge will be critical in a variety of high power aerospace applications. Capacitors are ideal for these purposes, as well as for power conditioning and filtering. Unfortunately, bulk powder-based dielectrics used in capacitors have severe limitations, especially the high number of short-inducing defects caused by poor control of material properties in ceramic fabrication processes. We propose to leapfrog current capacitor technology through the controlled growth of high dielectric constant and high dielectric strength thin films on mechanically strong substrates. High rate MOCVD is proposed as a growth method, similar to what is currently used in industry to make cm thick ZnSe IR windows. In Phase I, methodology will be developed to deposit thick Ba(x)Sr(1-X)TiO(3) films on conducting oxide electrodes for use in high energy density capacitors. In particular thick films of Ba(0.5)Sr(0.5)TiO(3), which has demonstrated dielectric constants greater than 800 with breakdown voltages of 1.5-2 mv/cm (45-60 kv/mil), will be grown. In Phase II, the MOCVD deposition process will be scaled up to commercial volumes, multilayers and electroding examined, and partnerships established to validate this technology in the marketplace through the construction of prototype high energy density capacitors.

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Topic#: 93-014
Office: BMDO
Contract #: DNA001-93-C-0091
PI: George Brandes

ID#: 93-734

Title: Negative Electron Affinity Diamond Vacuum Collector Transistor

Abstract: Semiconducting diamond has many novel properties, most notably a stable Negative Electron Affinity (NEA) surface. Conduction band electrons are readily emitted from a NEA material because the bulk conduction band lies above the vacuum level. In the Phase I program we will construct a NEA diamond vacuum collector transistor and investigate the performance of the device. The diamond transistor is expected to have exceptional high frequency and temperature performance. Phase II will extend the Phase I program to include full device design, fabrication, and testing. Phase III we will expect rapid commercialization of the devices in microwave communications, flat panel displays, and ultra fast switches.

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Topic#: 93-014
Office: BMDO
Contract #: F33615-93-C-2331
PI: Michael A. Tischler

ID#: 93-744

Title: Doped Silicide OHMIC Contacts To Silicon Carbide

Abstract: OHMIC contacts are key to the implementation of Silicon Carbide (SiC) high power, high temperature devices. To date, contacts to SiC made using conventional techniques have demonstrated neither low contact resistances nor long term

stability. In Phase I we will develop low resistance silicide based OHMIC contacts specifically aimed at SiC high temperature, high power devices. Contacts will be fabricated using a novel doping techniques to heavily dope the semiconductor-silicide interface and via a unique silicide formation process. Controlled formation of silicides will eliminate the problems of excess carbon and carbide formation at the contact interface. In Phase II, we will evaluate the long term electrical and structural stability of the contacts in high power, high temperature devices. In Phase III, specific DoD and commercial devices will be targeted for manufacture.

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Topic#: 93-007 ID#: 93-208
Office: BMDO
Contract #: F33615-93-C-2327
PI: John Hendricks, PHD
Title: Thermally Driven Hot Piston Pulse Tube (Vuilleumier) Refrigerator
Abstract: The ability to lift heat from a selected portion of the spacecraft is required in a number of thermal management tasks for spaced based sensor and weapon systems. The proposed effort will develop the theoretical and analytical framework to assess the utility and feasibility of a hot piston pulse tube vuilleumier refrigerator. The effort will identify a baseline application for the proposed concept, and will adapt existing analytical tools and generalized thermodynamic cycle analysis tools to the analysis of HPPT-Vuilleumier refrigerators. The effort will also identify acceptable candidate materials and fabrication methods for constructing the required refrigerators, including regenerators and heat exchangers. Finally, the effort will develop a preliminary design and test plan for an engineering model to be fabricated and tested in Phase II to validate the analytical and modeling tools developed in Phase I.

ANALYTICON CORP.
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Phone: (310) [illegible]9-1964
Topic#: 93-010 ID#: 93-203
Office: BMDO
Contract #: N00014-93-C-0182
PI: John Wagner
Title: Enhar [illegible]hicle and Event [illegible]oftware
Abstract: [illegible] proposes develop[illegible]n enhanced software technique for pattern recognition that will be a fully integrated procedure, [illegible]or techniques. The objective is providing a tool for testing key assumptions, internal compatibility, and performance of radiometric typing algorithms - per issues of ramifications on signature uncertainty statistics of signature mapping to a best decision-making hyperspace of coordinates statistical compatibility of decision rule and coordinates of impact of mis-modeling (per hyperspace determination, payoff criterion choice / pre-conditioning, quantification of statistical uncertainty moments, measurement noise effect). This effort will automate a complete albeit simple solution for readily identifying, using radiometric measurements of an observed vehicle's or event's signature, the corresponding type of similar radiant intensity characteristics to other candidates. This software is applicable to military topics of vehicle/weapon classification, treaty compliance verification, and diverse societal applications. The preliminary design and feasibility of the proposed software will be established during Phase I. Accordingly it will be coded, implemented and tested on PCs. The resultant design will be refined and its performance evaluated in-depth during an envisioned Phase II effort.

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Topic#: 93-016 ID#: 93-175
Office: BMDO
Contract #: DNA001-93-C-0097
PI: Meng-Kun Ke, PHD
Title: Active Radio Frequency Applications
Abstract: Active Radio Frequency Cavity (patent pending, or ARFC) is a concept which enables the integration of a large number of low-power transistors or other solid state devices into a resonant RF cavity, forming a monolithic light-weight, high-efficiency, high-power structure. The low operating voltage of the ARFC (10s of volts to 100+ volts) reduces the costs of high-voltage power supplies and power conditioning equipment. If the cavity is that of a resonant RF particle accelerator, the system is termed an integrated RF power accelerator cavity or IRFPAC. It can be shown that accelerating fields on the order of mv/m can be achieved with state-of-the-art SSDS. Alternately, if the high RF power is piped out of the cavity via wave guide or coaxial cable, the system is then deemed an active RF cavity amplifier, or ARFCA. It is demonstrated that tens of kw of RF

power can be obtained at about 80% efficiency at UHF to l-band frequencies.

ASPEN SYSTEMS, INC.
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Phone: (508) 481-5058
Topic#: 93-003 ID#: 93-540
Office: BMDO
Contract #: N00014-93-C-0179
PI: Michael Tilleman
Title: Remote Measurements Of Clouds And Fog
Abstract: Aspen Systems proposes an innovative apparatus for remote measurement of cloud and fog parameters, such as water content. This lidar apparatus uses state-of-the-art laser technology to measure the properties of a cloud or fog (constituent, water droplet size and concentration) regardless of ambient light conditions (day or night) or location of deployment (ground based or airborne). The proposed lidar is based on Stimulated Raman Scattering (SRS) occurring in liquid droplets, and we call it "SRS lidar". Unique to the SRS lidar method is that it generates signals significantly stronger than state of the art lidars. In addition, it is an exclusive means for the measurement of the water droplet dimension and size distribution. This will provide SDIO and the US Armed Forces with an enhanced capability of predicting weather conditions and enhance images acquired by spy satetiles and reconnaissance aircraft. In Phase I we will perform a laboratory demonstration that will prove the feasibility of the proposed concept. Accordingly, an ensemble of water droplets will be diagnosed. Based on the experiment results and calculations of a model, a design of a deployable SRS lidar will be made. A prototype of the apparatus will be assembled and tested in Phase II.

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Phone: (508) 481-5058
Topic#: 93-005 ID#: 93-614
Office: BMDO
Contract #: DNA001-93-C-0102
PI: Joseph Piche
Title: High K, Low Loss Selenium Polymers For Lightweight Capacitors
Abstract: Aspen systems proposes to develop high dielectric constant (K) selenium polymers to meet the design objectives of High Energy Density Capacitors (HEDC) for energy storage in pulsed power systems (15 to 45 mJ/kg). In the proposed Phase I we will synthesize highly processable, Se based polymers and fabricate samples of film for dielectric analysis. Initial, rigorous calculations have been performed based on quantum mechanical models (DMOL) which indicate that these materials have a substantially higher (>200%) dielectric constant than PVDF with a predicted dielectric constant of 20 to 30. Unlike PVDF these Se polymers materials are predicted to have high dielectric strength and low loss. Our models predict the K values for substituted Se compounds are significantly higher than those of the corresponding sulfur and oxygen based compounds. Dr. Welsh, University of Missouri, will contribute $50,000 in hardware and software for their evaluation. These polymers are crucial to the development of HED capacitors for space power systems and conditioning.

ASTRALUX
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Topic#: 93-014 ID#: 93-230
Office: BMDO
Contract #: F33615-93-C-1272
PI: Moeljanto Leksono, PHD
Title: ECR-Ion Beam Deposition for III-Nitride Semiconductors
Abstract: We propose to develop and study a new manufacturing technology for the epitaxial growth of multilayers of III-Nitrides semiconductors (GaN and AlGaN) at temperatures substantially lower than presently achieved. The technique is based on the ion beam deposition system where the Ions are generated by an Electron Cyclotron Resonance (ECR) microwave plasma. The energy of the ions incident on the substrate are controlled by a grid electrode which allows them to have the high surface mobility required for epitaxial growth at low substrate temperatures. Since ECR plasmas are a rich source of ionic species, high deposition rate should be achieved using this technique. The low substrate temperatures will result in abrupt interfaces between different layers because interdiffusion between layers will be greatly reduced. Furthermore, low substrate temperatures also reduce the stress due to different thermal expansion coefficients of the substrate and the growing layer. The use of low-pressure reactants to synthesize multilayer structures will greatly reduce the material cost, while the automation of the deposition process will reduce labor costs. An ECR Plasma-assisted metalorganic chemical vapor deposition (PA MOCVD) is available that, with minor modifications, can demonstrate this technology.

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Topic#: 93-014 ID#: 93-231
Office: BMDO
Contract #: N00014-93-C-0149
PI: Chang Qiu
Title: Rare Earth Doped III-V Semiconductor for Optoelectronics
Abstract: The proposed research and development effort will explore the electroluminescence properties of rare earth elements in a III-V semiconductor. The technique of impact excitation, currently used in commercially available electroluminescence display devices, will be studied for exciting the rare earths. We have already demonstrated the possibility of generating visible light by hot electron impact excitation in a III-V semiconductor. We propose to introduce Erbium (ER) atoms into a III-V semiconductor as a luminescent source for 1.55um light emission. Previously fabricated on-hand devices will be doped with ER atoms by ion beam implantation techniques. This will permit rapid evaluation of the efficiency of electrically exciting ER luminescence. We will also grow new structures by the plasma-assisted chemical vapor deposition method incorporating a metalorganic source of ER. This allows growth of ER-doped semiconductors at low temperatures, thus minimizing thermally-induced stresses. These samples will be characterized by a number of analytic methods and compared to the ion implanted/high-temperature annealed material.

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Topic#: 93-014 ID#: 93-233
Office: BMDO
Contract #: F33615-93-C-1273
PI: Chang Qiu
Title: Wide Bandgap Semiconductors for High-Temperature Electronics
Abstract: This project proposes to explore the use of a wide bandgap semiconductor to make devices capable of operating at temperatures of at least 500°C. PN junctions will be fabricated. The major thrust will be the study of electrode technology to make OHMIC contacts that are stable at high temperature and in the presence of an electric bias. The appropriate metallization must resist both thermal diffusion and electromigration during operation at high temperatures. Ultimately, this research will lead to a bipolar transistor, probably of the NPN variety. Success with high-temperature OHMIC contacts will permit the fabrication of high-temperature Field Effect Transistors (FETs). These devices, both the bipolar and unipolar varieties, should be responsive to UV illumination, essentially permitting their operation as phototransistors or photo-FETs. We shall test the temperature stability of these devices up to 500°C and determine the maximum temperature at which such a structure can be operated.

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Topic#: 93-014 ID#: 93-270
Office: BMDO
Contract #: DASG60-93-C-0087
PI: Chang H. Qiu
Title: Biotechnology Applied Nanostructures
Abstract: We propose to apply a biotechnology-based process to make nanostructures for optoelectronic applications. The result will be a uniform array of silicon quantum boxes of identical dimensions in a silicon layer of controlled thickness. All three techniques, controlled thickness of a crystalline Si layer, formation of a uniform array, and its use as a pattern for replicating a semiconductor array, have been demonstrated experimentally. We propose to combine and adapt these techniques to generate a uniform array of identical Si quantum boxes. Their properties will be characterized by various analytical techniques including photoluminescence spectroscopy.

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Phone: (302) 366-0400
Topic#: 93-005 ID#: 93-387
Office: BMDO
Contract #: F33615-93-C-2337
PI: Margaret H. Hannon
Title: High Specific Power, Electrostatically Bonded, Ultra-Thin GaAs
Abstract: Astropower proposes to develop a lightweight, high performance, ultra-thin electrostatically bonded GaAs solar cell with coplanar back contacts. The innovative design incorporates light trapping, adhesiveless cover slide bonding, and eliminates

grid shading. This novel device will exhibit increased efficiency and specific power due to the higher open circuit voltage and short circuit current obtainable from a thin device. An optical reflector is used to increase the short circuit current while maintaining reduced bulk recombination. Because the thickness of the GaAs solar cell is less than 2 microns, the device is supported by a 3-mil thick cover glass that is electrostatically bonded to the front surface. The specific power for this novel solar cell is 3549 w/kg with an AMO efficiency of 24.5%. Thermal stability and tolerance to UV degradation are inherent to the thin device structure and electrostatically bonded cover slide. Successful development of this technology can result in a revolutionary improvement in survivability, performance, and lightweight GaAs solar cell products for space.

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NEWARK, DE 19716
Phone: (302) 366-0400
Topic#: 93-005 ID#: 93-584
Office: BMDO
Contract #: DASG60-93-C-0070
PI: Jeffrey E. Cotter
Title: Monolithically Interconnected, Thin Silicon Solar Cell Array
Abstract: Astropower proposes to develop a lightweight, high efficiency, monolithically interconnected thin silicon solar cell array. The array incorporates an innovative technique to achieve electrical isolation and interconnection of the array elements. A monolithically interconnected array technology offers reduced cost and complexity as well as increased reliability and yield compared to conventional solar cell array interconnection technologies. The proposed device will incorporate many high performance features to enhance array efficiency. The array elements will be electrostatically bonded to a thermally matched glass superstrate and chemically thinned, resulting in a lightweight, high specific power array. Front and back surface passivation and light trapping will be incorporated to enhance the array efficiency. The Phase I program will focus on the demonstration of a lightweight silicon solar cell array using monolithically interconnected elements. The goal will be to demonstrate the feasibility of this process by fabricating a series connected (5-10 volts), 25cm², 18% efficient, solar cell array.

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Phone: (619) 792-8501
Topic#: 93-003 ID#: 93-608
Office: BMDO
Contract #: DASG60-93-C-0106
PI: Eric Korevaar
Title: Compact, High Power Millimeter Wave Generator
Abstract: This proposal is for the study and development of a compact, high power tunable millimeter wave generator. Specifically it is for a compact orotron tube operating in the 94 GHz (W-band) range with power outputs on the order on 10 watts. Successful development of the orotron devices depends critically on two key technologies, the generation and propagation of a high current density sheet-like electron beam, and the high Q open resonator orotron cavity. High current density (>20a/cm²) sheet electron beam from a rugged LAB(6) cathode electron gun has recently been developed. This type of electron beam allows tight coupling between the electron beam and the orotron diffraction grating. The orotron diffraction grating is built as a part of the lower cavity mirror assembly. Conventional open resonator cavity analysis technique is inadequate. New analysis technique is required. The proposed research will lead to a compact orotron tube that enjoys high power output, wide frequency tunability, and extremely pure spectral output at W-band. Future research can scale the device into higher frequency. Phase I work will be devoted to evaluation and conceptual design of the system and evaluation and preliminary design of the compact, high power W-band millimeter wave orotron tubes.

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Topic#: 93-003 ID#: 93-555
Office: BMDO
Contract #: N00014-93-C-0177
PI: Eric Korevaar
Title: High Current Density Sheet-like Electron Beam Generator
Abstract: This proposal is for the design optimization and testing of a high current sheet-like electron beam generator. Specifically it is for a high current density (>20a/cm²) sheet electron beam source using a rugged LAB(6) cathode. Sheet electron beams are very desirable for coupling to the evanescent waves in small millimeter wave slow-wave circuits, in order to generate larger powers. LAB(6) is one of the best thermionic cathode materials producing very output current density for a given evaporation rate. LAB(6) can be repeatedly exposed to air without compromise to its emission properties. However, it

must operate at higher temperatures than conventional cathodes. To build a reliable LAB(6) based ribbon electron gun requires effort in the thermal design to minimize the necessary OHMIC power. The proposed study will attempt to reach an optimized design and will compare experimental results with the design predictions.

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Topic#: 93-005 ID#: 93-669
Office: BMDO
Contract #: N62269-93-C-0570
PI: ERIC KOREVAAR

Title: Extremely Narrowband Sodium Line Filter For Daytime Adaptive Optics

Abstract: The objective of this research is to see if an extremely narrowband sodium faraday atomic line filter can be used to allow adaptive systems using a sodium laser guide star to work under daytime light conditions for applications such as imaging satellites. The potential applications of the filter technology are based on the extremely small background light acceptance bandwidth of the filter (about .005 nm), Its potential for throughput efficiencies (including polarization losses) of around 30%, and the fact that its transmission band overlaps a solar Fraunhofer line with an additional factor of 20 reduction in background light. Calculations of daytime adaptive optics system performance using the filter will be carried out, and a filter appropriate for an adaptive optics system will be designed and built. The filter will be tested for throughput, out of band rejection, and spectral response to verify its predicted performance.

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Topic#: 93-014 ID#: 93-693
Office: BMDO
Contract #: F33615-93-C-2311
PI: Eric Korevaar

Title: Electron Beam Amplification Using Thin Diamond

Abstract: Diamond has a negative electron affinity on its (111) face and P-type diamond is conductive. Unfortunately, doping of diamond to make it conductive decreases the carrier mobilities while increasing the trap densities. Experiments with P-type diamond have not yet produced significant currents. In the proposed study an entirely new approach is investigated. Y thin wafers of natural type II A diamond are made conductive via electron bombardment. Carrier pairs are produced in the diamond at the rate of one pair per 16.5 eV of bombarding electron energy. The generated carrier pairs are available to be drawn out into the vacuum before they become trapped or recombine. For a bombarding energy of 30 keV for instant, a current gain of 1800 could be realized. The scheme is thus one of current amplification. The exciting electron beam could come from a field emitter array, leading to an all solid state cold electron source with high current density and high current output.

ATLANTIC AEROSPACE ELECTRONICS CORP.
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GREENBELT, MD 20770
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Topic#: 93-010 ID#: 93-346
Office: BMDO
Contract #: N00014-93-C-0174
PI: David Coomber

Title: Target Recognition Using Associative Parallel Processors

Abstract: SDIO has the difficult problem of finding targets in clutter with practically no tolerance for error because of the automated nature of response and the short times involved. Target recognition in clutter requires high speed computation and the optimum use of parallel processing to produce results in a timely way. Atlantic Aerospace has developed on-linear algorithms based on gray scale morphological signal processing that have demonstrated important target recognition capability. The Department of Defense has supported the development of many generations of non Von Neumann computer architectures. Among these, the Single Instruction Multiple Data (SIMD) architectures especially exploit the parallel nature of the algorithms used in image processing. Among the SIMD machines, we believe that associative parallel processors with content addressable associative memory are well matched to this application. However, exploitation of the existing associative parallel processors requires careful analysis of their specific implementation as applied to a specific class of applications. We propose to map the various components of the morphology-based target detection/recognition into the architecture of the currently available associative parallel processors with content addressable memory to optimize execution time of a class of algorithms used for target recognition.

BBT TECH
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Phone: (716) 657-5391
Topic#: 93-013 ID#: 93-338
Office: BMDO
Contract #: DASG60-93-C-0137
PI: Ted Twietmeyer
Title: Optical Time Division System to Replace Standard Matrix Switching
Abstract: This proposal encompasses a new technological idea. This idea is based on a patented working optical backplane technology without fiberoptics. Project engineers throughout the U.S. have long sought after a replacement for complex, unreliable matrix switching. This technology eliminates all relay matrices and CMOS integrated circuits. These devices are currently used for both switching analog signals and data. It increases reliability by eliminating moving contacts. The digital optical technique employed provides infinite signal isolation and zero crosstalk. BBT Tech's system employs ultra-high-speed time division multiplexing. The idea is similar to that used in telephony. However, this system operates at sustained data rates of several hundred megabytes to one gigabyte per second or faster. The optical backplane is constructed from simple plastic materials, and injection molded for only a few dollars per system. Matrix switching technology has not changed since 1970 when reed relays replaced the popular crossbar switch. Multi-stage switches provide path redundancy. Troubleshooting problems for these systems are both difficult and time consuming. Multi-stage switching became popular because of unreliable nature of relay contacts. The technology in this proposal is based on sound principles. It eliminates reliability problems. The benefits are real and can be proved.

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Topic#: 93-005 ID#: 93-756
Office: BMDO
Contract #: N00014-93-C-
PI: Rodney Lafollette
Title: Bipolar Lead Acid Batteries Using Polymer/carbon Composite Bipolar
Abstract: Workers at Brigham Young University, Bipolar Technologies, have developed a material for use as a bipolar electrode support which will result in more lightweight, longer life batteries. The electrode support is a composite material composed of low surface area carbon/polymer composite material which has low electrical resistance, chemically stable, and has low activity for oxygen evolution, an undesirable side reaction in lead acid batteries. It is proposed to apply this material as a bipolar electrode support. The projected specific power of batteries which use this material, and using the battery design previously demonstrated, is over 400 kw/kg for discharges of 1 - 3 ms. The specific power for longer discharges, although somewhat lower, are still many times that of other available batteries. This support material should also be useful in other battery systems for improved specific power, specific energy, and shelf life.

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Phone: (703) 848-0800
Topic#: 93-003 ID#: 93-519
Office: BMDO
Contract #: DASG60-93-C-0077
PI: Suman Ganguly
Title: Compact Infrared Grating Laser
Abstract: A theoretical program is proposed to investigate a compact, low-voltage infrared grating laser with multi-kilowatt output capability. The radiation is generated by the passage of an annular beam of electrons through a coaxial pair of conductors, the inner conductor being a corrugated cylinder which forms the grating. The electron beam is guided by an axial magnetic field. The dimensions of the optical resonator and of the electron beam are larger than the operating wavelength, thus permitting high power operation. Three issues will be addressed by this proposal. First, the quality of the electron beam required to generate infrared radiation. Second, the design of a low-loss, frequency-selective grating based infrared resonator. Finally, the effect of mode competition in the multiwave system on the efficiency and output mode purity.

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Topic#: 93-014 ID#: 93-541
Office: BMDO
Contract #: DNA001-93-C-0092
PI: Chien-Hsiung Peng
Title: Ferroelectric Thin Films For Nonvolatile Memory Applications

Abstract: It is well known that fatigue of ferroelectric thin films was reduced significantly since ceramic electrodes such as RuO(X) were developed. It is, however, realized that high leakage current with earlier electrical degradation and poor retention properties are still problems that need to be solved for commercial memory applications. A fast polarization decay occurs at the initial stage of retention (or aging), which is called imprint. In Phase I work, the imprint phenomenon will be modeled quantitatively based on the behavior of mobile charges in conjunction with domain boundaries, grain boundaries, and ferroelectric-electrode interfaces. Aging will also be correlated with the imprint. The imprint phenomenon will be reduced in two ways: 1) improvement of existing low-fatigue ferroelectric-electrode configurations such as RuO/PZT/RuO(X) and 2) use of new ferroelectric materials such as YMnO(3). Space charge concentration, the key role of the imprint phenomenon, due mainly to oxygen vacancies will be minimized by using dopants such as La or Nb in PZT films. YMnO(3) is believed to have better aging and imprint properties because of its low defect concentration such as oxygen vacancies. Simple nonvolatile memory devices will be fabricated and tested using MOCVD doped PZT or YMnO (3) films during Phase II.

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Topic#: 93-010 ID#: 93-603
Office: BMDO
Contract #: DASG60-93-C-0131
PI: Timothy Kay

Title: Image Processing Environment And Language

Abstract: Cognitech, Inc. proposes the creation of the "IMPEL: Image Processing Environment and Language," which combines a graphical user interface, a domain-specific programming language, and a domain-specific compiler into a powerful image processing tools. The IMPEL system includes a new Very High Level Language (VHLL) designed specifically for the task of image processing, and will facilitate the development and testing of image processing applications. The IMPEL language will produce code to run on scientific work stations and can potentially produce code to run highly parallel processed architectures. IMPEL will provide: 1) a domain-specific language for image processing. The IMPEL language will provide users with the expressibility necessary to easily implement image processing algorithms, but without the overhead required in a general purpose programming language. 2) a compiler that translates the IMPEL language into machine code. The IMPEL compiler can potentially produce code that performs computations as fast as, or faster than, hand coded programs written in a general purpose programming language. 3) a graphical user interface that manipulates images in much the same way that a spreadsheet program manipulates numerical calculations.

CONCEPTUAL SOFTWARE SYSTEMS, INC.
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Topic#: 93-003 ID#: 93-219
Office: BMDO
Contract #: N00014-93-C-0172
PI: Ed Andert, Jr.

Title: Wet Process for Sensor-Based Motion Detection

Abstract: Sensors associated with early-warning systems must detect ballistic missiles, which appear as moving point targets. Tracking techniques based on conventional signal or image processing algorithms require significant computational resources, provided by digital processors that are remote from the focal plane. We propose here a novel method for motion detection that can be implemented on-board the focal plane. This method, called the wave process, is a velocity bandpass filter for two-dimensional staring mosaic focal planes detecting moving point targets. It is resilient to background variations, platform jitter, and slight changes in target speed and direction. It is a distributed architecture, allowing it to identify many simultaneous regions of motion without suffering a slowdown. It is efficiently implemented in subthreshold VLSI which allows on-focal-plane application reducing system size, weight and power. Using preliminary exploratory research results on the wave process, this Phase I project will determine the feasibility of the approach for Missile Defense Systems. We will extend our theoretical understanding of the process and develop a simulation to demonstrate its performance under a variety of conditions.

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Topic#: 93-015 ID#: 93-193
Office: BMDO
Contract #: F19628-93-C-0127
PI: Joe Martens

Title: K and V Band Hybrid Flux Flow Communications Subsystems

Abstract: In Phase I of the proposed effort, a hybrid superconducting/semiconducting communication subsystem for K and V Band applications will be analyzed and designed. The system will consist of High Temperature Superconducting (HTS) feed networks, HTS phase shifters, and a conventional amplifier in a phased array framework. Digital post processing (analog to digital conversion coupled with a fast memory) may be based on superconducting flux flow transistors: high speed, three terminal devices that have been shown to operate up to 100 GHz. The amplifiers would probably be made from cooled hemt technology for superior noise performance. The final stages of system design will also choose between receive-only and transmit/receive formats based on expected power handling capabilities. In Phase I, this system would be designed down to a reasonably low level. In a Phase II project, the final detailed design would be completed and the subsystem built and tested. The subsystem would be designed to function with at least a 4x4 element patch radiator array and both K & V Band demonstrations would be built.

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Topic#: 93-015 ID#: 93-587
Office: BMDO
Contract #: DASG60-93-C-0118
PI: J. Kelly Truman, PHD

Title: HTS SNS Devices on Large-Area Substrates By Single-Source MOCVD

Abstract: In Phase I of the proposed effort, a novel, single-source Metalorganic Chemical Vapor Deposition (MOCVD) technique ...e applied to the fabrication of devices employing Superconducting-Normal-Superconductor (SNS) Josephson junctions. ...uctus recently developed a YbCO-based SNS junction using CaRuO(3) as the epitaxial barrier layer in the edge junction ...metry, the performance of which is promising for application to sensors as well as circuit elements. Since the critical current can be controlled by the thickness of the normal barrier layer, the fabrication of SNS devices offers promise for large-scale production because this thickness can be easily controlled. However, the existing YBCO deposition technology is limited in its capability to uniformly coat large-area substrates. A solid-state, single-source MOCVD technique, which has been used to reproducible grow high-quality epitaxial YbCO and other oxide thin films and multilayers on substratesas large as four inches in diameter, will be used to fabricate YbCO/CaRuA(3)/YbCO SNS edge junctions on two inch diameter substrates. The uniformity of the electrical properties of the SNS junctions will be tested.

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Topic#: 93-013 ID#: 93-471
Office: BMDO
Contract #: N00014-93-C-2106
PI: R. J. Weimer

Title: Advanced Intermetallic Matrix Composites

Abstract: Many current and planned defense aerospace programs depend critically upon rapid development of lightweight composite materials having unprecedented high-temperature properties. Continuous fiber reinforced Intermetallic Matrix Composites (IMC's) have the potential to meet these performance requirements, and considerable research effort is now devoted to developing them. We recently demonstrated a novel method for manufacturing continuous silicon carbide fiber-reinforced titanium aluminide composites with excellent fiber distribution in a fine-grained matrix. Offering the materials designer remarkable access to microstructural variables, the process facilitates synthesis of non-equilibrium structures that will be exploited in Phase I to lower traditional consolidation and shaping temperatures from 1300 degree to 600 degree. A variety of continuous IMC precursors will be fabricated, consolidated, and characterized. Phase II would demonstrate pilot-scale production of IMC precursors and reproducibility of the consolidation and forming processes for prototype engineering structures.

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Topic#: 93-014 ID#: 93-254
Office: BMDO
Contract #: F33615-93-C-2340
PI: John Palmour, PHD

Title: 4H-Silicon Carbide for High Temperature Power MOSFETs

Abstract: The rapid development of the technology for producing high quality Single Crystal SiC wafers and thin films presents the opportunity to fabricate solid-state devices with power-temperature capability far greater than devices currently available.

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This capability is ideally suited to the application of power conditioning on the all-electric airplane, turbine engine actuators, and space-based power systems. These applications require switches and amplifiers capable of large currents with relatively low voltage drops. While conventional silicon power devices are already being used near their limits of operating temperature and power, the potential of SiC is just beginning to be demonstrated. Vertical power MOSFET structures fabricated in 6H-SiC with 50 v capability have already shown current and power densities as high as 191 a/cm² and 5.4 kw/cm². The specific on-resistance (R DS(on)) of these devices were as low as 37.5 m-cm². These devices showed good characteristics at temperatures up to 300°C. While these are promising results, it is predicted that much better results could be achieved if these devices were fabricated in 4H-SiC. The 4H polytype of SiC has been shown to have an electron mobility almost twice that of 6H-SiC, which would greatly reduce the R DS(on) of a SiC power device. Additionally, the wider bandgap (3.26 EV) of 4H will result in an even higher breakdown field than 6H-SiC, which in turn allows another reduction in R DS(on). Therefore, it is proposed that the use of 4H-SiC be evaluated for a high temperature power MOSFET. This effort will include the characterization of the electron mobility of 4H-SiC, parallel to the C-axis, using hall effect measurements. Planer MOSFETs will also be fabricated in 4H-SiC in order to determine the channel mobility of these devices. Additionally, one batch of vertical power MOSFETs will be fabricated to prove the viability of the structure. Both the planar and vertical devices will also be measured at high temperature.

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Topic#: 93-003 ID#: 93-052
Office: BMDO
Contract #: GASG60-93-C-0073
PI: G.M. Loiacono
Title: Crystal Growth of Li(6)Y(BO3)3:Nd(+3) for Solid State Laser
Abstract: The High Temperature Solution (HTS) method will be used to produce crystals of Li6Y(BO3)3 doped with Nd+3 for solid state laser applications. A suitable solvent system based on LIF-LiBO3 will be developed to give optimum size crystals. The effect of Nd+3 concentration on crystal growth and laser properties will be evaluated.

CSA ENGINEERING, INC.
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Topic#: 93-002 ID#: 93-432
Office: BMDO
Contract #: DASG60-93-C-0076
PI: Warren Gibson
Title: Passively Adaptive Viscous Damping Mechanism
Abstract: To prolong life and enhance the performance of SDI and other spacecraft structures, the effects of structural dynamics must be reduced. Passive damping has been demonstrated as an excellent means for vibration suppression, either alone or in concert with active control. The ideal passive damping solution for space applications would be lightweight and effective over wide ranges of frequency and temperature. None of the currently available options for passive damping satisfy all these criteria. The goal of this effort is to develop a viscous damping mechanism that will adaptively change to provide passive damping that is nearly constant with respect to temperature and therefore closer to the ideal than any other form of damping. This innovative concept will be completely passive: changes in temperature will directly affect the damping mechanism with no need for external power. The loss mechanism of viscous dampers relies on forcing fluid through a passage. When its temperature changes, the fluid's viscosity changes, and this directly effects the loss characteristics of the damping mechanism. The Phase I effort will demonstrate the feasibility of using thermal expansion properties in an innovative manner to compensate for changes in the fluid's viscosity by altering the internal mechanics of the damper. A prototype damping mechanism will be designed, built, and tested over a representative temperature of these mechanisms for aerospace applications.

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Topic#: 93-007 ID#: 93-502
Office: BMDO
Contract #: F33615-93-C-2333
PI: Martin R. Pais, PHD
Title: Spray Cooling of High-power Semiconductor Laser Diodes
Abstract: The current development of high performance laser diodes to be used in defense, super computers, telecommunications, and medicine has introduced a need for a radical change in the approach of laser diode/optics thermal management. In laser

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diode arrays, integrated circuits mounted together on a single substrate to form one level package allow higher laser intensities, varied frequencies at enormous size, and weight savings. However, with the denser packaging and higher intensities and currents is introduced a higher heat dissipation. Under conditions of high-heat-flux the temperatures and the thermal gradients can become considerable. This proposed effort will provide a novel technology for cooling laser diodes directly in the region of heat generation by spray (droplet impingement) cooling the bare device surface directly, (as opposed to gluing a heat sink and cooling the heat sink extended surfaces), with an electrically dielectric coolant. By coating the diode with a layer of thermally conductive, structurally invincible, and electrically dielectric diamond film, the laser diode arrays can be configured in single and multilayer configurations and can even be cooled with water. A high-heat-flux laser diode will be tested to determine the feasibility and enhancement in performance of spray cooling.

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Topic#: 93-001 ID#: 93-569
Office: BMDO
Contract #: DASG60-93-C-0114
PI: Jeff W. Pierce
Title: High Efficiency Quadrature Frequency Doubler
Abstract: At Cygnus Laser, we have become convinced that nonlinear optical materials with desirable properties for harmonic generation and frequency conversion already exist. In particular, we have already demonstrated a KTP second harmonic generator for 1064 nm lasers in our laboratory with a conversion efficiency of 80%. We understand in detail the physics of second harmonic generation well beyond the simple approximation which characterize most textbook analysis. During Phase I, we propose to develop for the SDIO a quadrature high efficiency frequency doubler capable of converting 532 - 266 nm with an efficiency of 70%, resulting in and overall 1064 - 266 nm system effiency of over 60%. While the materials technology used in our approach is mature, our device geometry is a radical departure from current UV generation systems.

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Topic#: 93-003 ID#: 93-568
Office: BMDO
Contract #: N00014-93-C-0178
PI: Jeff W. Pierce
Title: Stable Intracavity Nonlinear Optics
Abstract: Cygnus Laser proposes a revolutionary method of dynamically controlling the harmonic generation process. Present harmonic generation technology involves determining an optimum crystal size and length for a given fundamental laser, then using the crystal as a passive element. The only available control mechanisms are quite often mechanical alignment and temperature control. The crystal acts as a nonlinear intensity filter, generating harmonic light in a nonlinear fashion whenever the power threshold is reached. In all of these designs the crystal is a passive device. It reacts to light that passes through it. The proposed innovation would give the system real-time control over the SHG laser ouput pulse and would be completely adjustable from pulse to pulse.

DATA REFINING TECHNOLOGIES, INC.
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Phone: (504) 687-0887
Topic#: 93-010 ID#: 93-382
Office: BMDO
Contract #: DASG60-93-C-0094
PI: Bruce C. Moore
Title: Object-oriented Signal Processing
Abstract: The problem addressed is that of extracting information about events associated with a physical system by processing a large number of data streams flowing from sensors and instrumentation. It is assumed that deceptive data portions are imbedded, with no a-priori models describing system behavior. The objective is to formalize, articulate, and demonstrate a signal-processing framework (object oriented signal processing) which is emerging from experience with problems of this nature in commercial applications. In this setting instrumentation injects raw material into a material-processing framework, with a rigorous mathematical platform for developing condensation and classification processes. Condensation processes extract information from raw-material streams and inject it into highly compressed (1000:1) streams of synthetic material feeding classification processes. High performance gains result from applying intensive processing directly to compressed material. Classification processes produce groups of similar material characterized by distributions of material populations. There appears

to be a close relationship between these distributions and membership functions as used in fuzzy control.

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Topic#: 93-011 ID#: 93-518
Office: BMDO
Contract #: N60921-93-C-0110
PI: Mark Handschy
Title: Optical "Bond Pads" For Silicon VLSI
Abstract: We propose a novel method for providing optical modulator pads on silicon VLSI circuits. Our technique should enable modulator pad arrays of nearly arbitrary configuration, with minimum pad geometries of a few microns square. Modulator response times less than 1 ns should be achieved. The technique requires only a few process steps and will work on circuits made in any standard VLSI process.

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Topic#: 93-003 ID#: 93-490
Office: BMDO
Contract #: DASG60-93-C-0105
PI: Ned Corron, PHD
Title: Range Resolution in Radars Using LFM Envelope Processing
Abstract: Dynetics proposes a novel processing technique for increasing the range resolution capability of a large class of radars. This technique, Linear Frequency Modulation Envelope Processing (LFMEP), allows range resolution for LFM signals that is not limited in the usual way by the waveform's bandwidth. Theoretically, the technique is able to resolve two targets separated by as little as 10 wavelengths of the carrier frequency. This capability is achieved by processing the envelope of successively received LFM waveforms and does not require pulse-to-pulse coherency of the target. Dynetics proposes to advance LFMEP and demonstrate its capability for a radar system. During Phase I, Dynetics' objectives will be to complete development of the basic technique, to extend the method for multiple and fluctuating targets, and to pursue enhancements including alternative waveforms and post-processor application. This research will then provide the requisite background for field-testing in a Phase II tasking.

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Topic#: 93-013 ID#: 93-044
Office: BMDO
Contract #: DASG60-93-C-0086
PI: John L. Remmo PHD
Title: Embedded Laser Diode Sensor
Abstract: The "Embedded Laser Diode Sensor for Structural Materials," addresses SDIO's needs for innovative integrated self-calibrating sensors in advanced composite materials and structures for space operations and composite material quality control. The proposed semiconductor laser diode sensor making use of an external cavity coupling configuration which utilizes the resonator cavity as both an oscillator/amplifier and detector which measures KHz vibration, sub-micron displacement, micro-radian tilt and other quantities that can be monitored and corrected in real time. The sensor is reliable, has a long lifetime, uses 3 MW of power or less, has excellent precision and accuracy, is inexpensive (< $10 in quantity) and ideally suited for systems and array interfacing for digital signal processing. Proof-of-concept experiments for displacement have already been successfully carried out with 820, 780, and 740 nm diodes. This research will concentrate on wavelengths in the (visible) range down to 650 to 620 nm. This recently patented technology builds on research funding driven by consumer electronic (CD player) technology and its implementation by SDIO assists low cost space systems and provides for additional commercial and industrial application.

ELECTRO-OPTICAL SCIENCES, INC.
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Topic#: 93-003 ID#: 93-422
Office: BMDO
Contract #: N00014-93-C-0147
PI: Marek Elbaum
Title: Direct Detection Range-doppler Laser Radar

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Abstract: The team of Electro-Optical Sciences (EOS) and SKW propose an innovative range-doppler laser radar for use on spaceborne platforms in TMD and strategic defense applications. The new laser radar utilizes a conventional ranger optically coupled with a novel Interferometric Doppler Detection (ID3) receiver recently invented by EOS. The laser radar will function as an adjunct to passive sensors used in detection, identification and tracking of ballistic missiles. The benefits of this laser radar for BMD applications are: 1) improved detection/identification of targets in clutter due to their unique doppler signatures; 2) rapid estimation target state vector with improved performance versus short-burn boosters (e.g., SCUD); 3) single satellite autonomous tracking which improves coverage versus short range and depressed trajectories. Phase I research will develop a preliminary design and performance analysis including necessary signal processing algorithms. Phase II effort will develop a breadboard sensor for feasibility demonstration through a series of laboratory and group based tests. Optical tracking test sites at ISTEF and WSMR are suitable for this demonstration. Data will be used to validate signal processing algorithms and fusion concepts.

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Topic#: 93-008 ID#: 93-164
Office: BMDO
Contract #: DNA001-93-C-0095
PI: James P. Spratt

Title: Radiation Hardening of CCD Imagers Using "Defect Control"

Abstract: CCDs subject to proton irradiation are degraded by the development of crystalline effects which impact quality. Since the concentration of active defects is proportional to the nile of protons in silicon, it has been assumed that the amount of damage cannot be controlled. However, examination shows that CCD degradation is caused by vacancies combining with dopant atoms or defects to cause vacancy complexes such as E-Centers and/or divacancies, and their contractions can depend on crystalline orientation (thru damage straggling), dopant levels, etc. Furthermore, since the E-center is an electron trap, will control the havior of N-type CCDs, while the divacancy, being a hole trap, will control the behavior of P-type CCDs. Thus, P-and N-CCDs will differ in hardness. Under this program, the equations for the mass balance of E-Centers and divacancies will be analyzed, and a model developed relating concentrations of each defect type to nile, crystalline orientation, etc. Based on this model, CCD designs will be developed which improve hardness by selecting the specific carrier type device and orientation which undergoes the least degradation in performance. Phase II will fabricate prototype hardened CCDs based on these designs.

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Topic#: 93-010 ID#: 93-455
Office: BMDO
Contract #: DASG60-93-C-0134
PI: Philip Brooke

Title: Actor Kernel For Computer Systems

Abstract: Finding and disabling a ballistic missile in flight requires the coordination of many, tightly integrated functional elements. Traditionally, such systems are designed as independent components with clearly defined interfaces, so that there is a clear separation between module and client. Such systems pass data to each other but do not otherwise collaborate in the overall system goals. They also are not very flexible in applying intelligence and processing power according to the hardware topology and dynamic system requirements. We propose to develop a distributed kernel and development system based upon expert actors. The kernel would be programmed in ADA. The actors themselves would be programmed by messages which would contain ADA code or references to ADA code. The actors would be hierachically related according to each actor's level of abstraction in an inheritance tree structure. The proposed kernel would be designed to handle complex system with features required of production software: distributed actor database, concurrency, rule-base in each actor, interface to 3rd party code, use of standards, and support for multi-processor machines and multiple platforms.

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Topic#: 93-010 ID#: 93-349
Office: BMDO
Contract #: DASG60-93-C-0067
PI: James Hardy

Title: Correc. Distributed Simulation Protocol

Abstract: The Correct Distributed Simulation Protocol (CDSP) is a unique and innovative protocol that directly addresses a need

in the emerging technology of distributed simulations. Distributed Training Simulations (SIMNET, DSI) do not, and are not required to produce correct results. They need only provide realistic cues. However, when distributed simulations are used for analysis purposes; for example, to assess whether a weapons system will perform to meet system requirements, the simulation must be correct. A correct distributed simulation, in this context, is repeatable and synchronized; the simulation gives the same answers each time it is run; the simulated sequence of events occurs in the same order in the distributed simulation as it would if it were not distributed. Correctness of distributed simulations is strongly affected by communications induced node-to-node latencies; correctness is also strongly affected by simulation design. Communication system characteristics that generate these latencies include speed of light delays, store and forward nodes, bandwidth induced latencies, and communications protocols. A principal simulation characteristic that interacts with these latencies is the degree of coupling among distributed simulation nodes. The correct distributed simulation protocol is a unique high level protocol that reduces application-to-application latency by addressing both communications and simulation design in order to achieve simulation correctness.

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Topic#: 93-002 ID#: 93-068
Office: BMDO
Contract #: N60921-93-C-0105
PI: Wayne Steffier

Title: Low Cost C/C Divert Thrust Chambers Via Rapid, Forced Flow CVI

Abstract: Kenetic Energy (KE) weapons currently in development or being considered under the Strategic Defense Initiative (SDI) include a variety of ground-and space-based interceptors. Many of these proposed systems are critically dependent on the development of advanced light-weight, high-temperature materials for axial and/or divert propulsion sub-systems. Recent hover tests of the leap kinetic kill vehicle has successfully demonstrated the potential of low-density, oxidation-resistant Carbon/Carbon (C/C) composites for divert thrust chamber (thruster) applications. Current state-of-the-art GBI and thaad C/C composite thrusters are being fabricated using 2-D triaxially braided carbon fiber preforms which are subsequently densified with Pyrolytic Carbon (PYC) by methods of conventional Chemical Vapor Infiltration (CVI). Conventional, isothermal/isobaric CVI techniques require intentionally slow deposition rates in order to uniformly infiltrate and densify the fibrous preforms while minimizing through-the-thickness density gradients. These slow CVI densification processes routinely require 300-600 hours to complete, resulting in very long product lead times and thus relatively high product cost. The objective of this Phase I program is to develop and evaluate an innovative forced flow CVI process for the rapid densification of C/C composite divert thrusters. The goal of this development is to successfully reduce the densification cycle by at least 75%, resulting in a composite thruster fabrication cost reduce of over 50%. Triaxially braided, multilayer carbon fiber proforms will be fabricated over geometrically contoured mandrels and rapidly densified with pyc using an economical forced flow CVI technique. Process conditions will be established for densifying the thruster component to a target density of 1.75 gm/cm3 in less than 100 hours. Following detailed machining, an Integrated/Adherent Oxidation-Protective Silicon Carbide (SIC) coating will be applied to the interior surface of the thruster components by CVI. Tubular composite test specimens, representative of both the combustion chamber and the nozzle regions, will be prepared and experimentally evaluated to determine the high-pressure permeability and burst pressure characteristics.

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Topic#: 93-003 ID#: 93-043
Office: BMDO
Contract #: DASG60-93-C-0120
PI: Masoud Radparvar

Title: Superconducting Photomultiplier: High Sensitivity Detection

Abstract: Josephson Junction photomultiplier niobium tunnel junction hypres utilizes a thin, optically sensitive, multilayer superconducting film which forms one electrode of a Josephson Junction used for detecting ultra-violet, optical and infrared radiation. The superconducting photomultiplier, a fundamental advance beyond junction detectors, employs a separately optimized detecting layer, mated with a high quality niobium amplifying junction. It will provide subnanosecond optical response, ultra-low noise and high responsivity from UV through the infrared. Hypres has already fabricated the key element, a niobium nitride layer over a niobium tunnel junction, as well as YbCO film and niobium tunnel junctions on the same substrate. The gain of such devices is estimated to be in excess of 100. This technology allows combining superconductive signal processing circuits with optical receivers and active and passive focal plane arrays.

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HYPRES, INC.
175 CLEARBROOK ROAD
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Phone: (914) 592-1190
Topic#: 93-015 ID#: 93-139
Office: BMDO
Contract #: DASG60-93-C-0091
PI: Elie Track, PHD
Title: Quasi-Optical Josephson Oscillators

Abstract: Hypres proposes a program to develop and demonstrate 100 GHz to 2,000 GHz (submillimeter) oscillators. These oscillators are based on a novel implementation of the josephson effect in niobium superconducting integrated circuits: the Quasioptical Josephson Oscillator (QJO). The QJO will radiate coherently in the submillimeter range when low voltage DC power is applied to it, just as the laser diode operates in the infrared and optical range. The QJO will have a few octaves of frequency tuning available by changing the DC voltage applied. The effort we propose is in collaboration with Professor Wengler of the University of Rochester. Wengler's novel design involves a 2-dimentional array of Josephson Junctions with the generated power radiated through dipole antennas. Submillimeter sources currently available tend to be very low power with limited tuning, or require kilovolt power supplies. On the other hand, niobium thin films and integrated circuits being developed at Hypres have matured into a manufacturable and reliable technology, with recent demonstrations at Hypres of flash and counter-type analog-to-digital converters, RSFQ shift registers, superconducting memories, and a variety of logic gates. Hypres has earlier successfully introduced a 70 GHz superconducting digitizing oscilloscope and TDR which to this date retains the performance record of any competing instrument. Our goal is to demonstrate the Wengler QJO with Hypres' niobium technology, and to test a number of particularly promising QJO designs. We will combine Hypres' process expertise with Wengler's Josephson sources' expertise to produce monolithic submillimeter wave oscillators of unprecedented efficiency, tunability, and convenience.

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Topic#: 93-015 ID#: 93-224
Office: BMDO
Contract #: N00014-93-C-2119
PI: Perng-Fei Yuh, PHD
Title: Dense Superconducting Memories with Column Sense

Abstract: A new class of superconducting memories with a column-sense technique is proposed to make very dense memory possible. All the existing Josephson memory cells use one sense gate per cell. As a consequence, the cells are complicated, and the cell size is not readily shrunk. The proposed sensing scheme uses one sense gate to sense a group (usually a column) of memory cells, and therefore, the cell can be simplified with the smallest possible area. This idea is very general, not limited to a particular memory cell design. In addition, the memory cells are compatible with the new high temperature superconductor materials since latching sense gates are not necessary. To illustrate this idea, we show that the 3-squid memory cell used in our 2-KB memory chip can be simplified to a 1-squid cell with one sense gate per 256 cells. The Fujitsu's 2-JJ capacitively coupled memory cell can also be shrunk to a 1-JJ cell without a capacitor. A factor of 2 to 10 reduction in cell size can be readily achieved using the same design rules. In Phase I, we will demonstrate the feasibility of column sense in NB technology. In Phase II, a superconducting cache chip of 4 to 16 KB will be built. The implementation of a memory chip in NBN technology operating at 10K will also be pursued in Phase II with a potential for operating YbCO memory at 30-40K. The memory density, cycle time, as well as design for testability are emphasized. In Phase III, the fabricated memory circuit will be integrated with a Hypres superconducting IR detector array and/or a superconducting signal processing unit.

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Topic#: 93-002 ID#: 93-453
Office: BMDO
Contract #: DASG60-93-C-0107
PI: Daniel H. Meyer
Title: Valveless Solid Propellant Divert Propulsion System

Abstract: Integrated Systems Inc. (ISI) and Industrial Solid Propulsion Inc. (ISP) have jointly defined a concept for a valveless solid propellant divert control of kinetic energy projectiles. ISP and consultant Dr. Bob Geisler evolved the multipulse propellant grain and dual-ended igniter design out of ISP's small rocket motor technology. ISI provided the guidance and control knowledge necessary to determine the control policy, minimum impulse bit sizing and overall Valveless Solid Divert (VSD) module sizing. In this proposal ISP proposes to develop and ground test the VSD module propulsion hardware. In another Phase I SBIR proposal submitted under separate cover, ISI proposes to develop and test a multipulse ignition controller for the VSD concept. The valveless solid divert concept integrates an appropriate number of individually-ignitable solid propellant grains, sized to

provide the minimum impulse bits needed to assure target hit-to-kill, into two double-ended chambers (or "modules") to provide plus and minus divert control along the desired two divert axes. Application of divert thrust is controlled by electronically-activated igniters instead of expensive and often unreliable hot-gas valves. The proposed VSD subsystem can be produced rapidly at a fraction of the cost of current solid propellant divert control subsystems.

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Topic#: 93-001 ID#: 93-604
Office: BMDO
Contract #: DASG60-93-C-0127
PI: George Kirkman, PHD

Title: High Current, High Brightness Ferroelectric Electron Source

Abstract: High current, high brightness advanced electron beam sources are required for directed energy experiments and commercial applications which include free electron lasers, high power microwaves, electron beam pumped lasers and microwave sources for communications, plasma processing and accelerator systems. Present sources such as thermionic and photocathodes are limited by current density, total current and are complex due to high vacuum, and laser requirements. We propose a high current, high brightness cathode based on emission from ferroelectric materials. Ferroelectric cathodes operate at room temperature using spontaneously polarized materials such as lead titanate-zirconate. Previous research at CERN, Cornell and Integrated Applied Physics has demonstrated these cathodes to produce high current density, high quality electron beams. Electron emission occurs upon polarization change induced by a fast almost 20 kv/cm pulse applied to the material. Our previous research has indicated high brightness, $>10(11)$ a/m^{2}rad^2 performance operating at pressures as high as 10 (-3) torr. Room temperature emission of electrons combined with high current capability, several 100 a/cm^2, given the possibility of beams with brightness $>10(12)$ a/m^{2}rad^2 which exceeds present photocathodes. During Phase I, we propose to demonstrate the source and determine the brightness capability at kilo-ampere peak currents. During Phase II, a commercial device will be developed for defense and industrial applications.

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Topic#: 93-002 ID#: 93-728
Office: BMDO
Contract #: DASG60-93-C-0101
PI: Michael Briggs

Title: Valveless Control of a Solid-Propellant Divert Subsystem

Abstract: Integrated Systems Inc. (ISI) and Industrial Solid Propulsion (ISP) have jointly defined a concept for valveless solid-propellant divert control of kinetic energy projectiles. ISP and consultant Dr. Bob Giesler evolved the multipulse propellant grain and dual-ended igniter design out of ISP's model rocket technology. ISI provided the guidance and control knowledge necessary to determine the control policy, minimum impulse bit sizing, and overall Valveless Solid Divert (VSD) module sizing. ISI proposes to develop and test a multiple ignition controller for the VSD concept. In another Phase I proposal submitted under separate cover, ISP proposes to develop and ground-test the VSD module propulsion hardware. The (VSD) concept integrates an appropriate number of individually-ignitable solid-propellant grains, sizes to provide the minimum impulse bits needed to assure target hit-to-kill, into two double-ended chambers (or "modules") to provide plus and minus divert control along the desired two divert axes. Application of divert thrust is controlled by electronically-activated igniters instead of expensive and often unreliable hot-gas valves.

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Topic#: 93-010 ID#: 93-342
Office: BMDO
Contract #: DASG60-93-C-0116
PI: Leonard S. Haynes

Title: Battle Management Based On Autonomous Agents

Abstract: Battle Management can be viewed, at least in part, as a complex optimization problem where there are threats of varying capability, and there are assets which can be used to sense and engage or intercept the threats. The problem is complicated by the fact that most of the sensor information has significance uncertainty and noise due to the physical limitations of the sensors, countermeasures, and in some battle scenarios, nuclear effects. Conventional optimization techniques are too slow for the command center needs, do not yield good results in the presence of uncertain and noisy data, and are brittle in the

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presence of unanticipated situations. SDIO battle management then becomes one of not a mathematical optimization, but one of heuristic reasoning, reasoning under uncertainty, and "rules of thumb." The problem domain approaches that of "deterministic chaos" where a very small change in some parameter may make a much larger change in the outcome. This proposal details how we will use "autonomous agents" to model the various elements within a battle situation, and then use these autonomous agents to either generate near optimal battle strategy, or provide decision aids to an operator. The proposal attempts to demonstrate that this approach will provide robust, near optimal results even in the case that the system is deterministically chaotic. The "autonomous agent" paradigm herein proposed for battle management is very much an AI technique. The literature contains excellent examples of how autonomous agents have been used to reproduce selected intelligent behavior of biological organisms. Our proposal details how this same paradigm will be used for battle management applications.

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Topic#: 93-003 ID#: 93-659
Office: BMDO
Contract #: DASG60-93-C-0109
PI: James D. Billingsley
Title: Millimeter Wave Focal Plane Array
Abstract: There has been a long-standing need for all-weather, day-night, passive imaging sensors to meet the requirements of numerous applications. The Microwave and Millimeter Wave (MMW) spectral regions are operational candidates for this need because the atmosphere has windows that are relatively transparent in all weather conditions. New W-band technology, in combination with new computer capabilities and image processing algorithms, now offer potential solutions to these requirements in a quasi-optical sensor design containing Focal Plane Arrays (FPAs) of many MMW receiving channels, potentially including superconducting FPAS. In this Phase I project, low-cost techniques will be investigated for producing large focal plane arrays of W-band millimeter wave receivers. The objective is to demonstrate feasibility of using microlithographic technology for producing such arrays. A large scale antenna array demonstration will be defined for the anticipated Phase II effort that will construct, test, evaluate and demonstrate an advanced development model. The recently invented type II strained layer superlattices made of GaInSb/InAs have shown great promise as IR detectors. Made of periods of materials each only a few atoms thick. It has several desirable optical and transport properties which would become even more important for VLWIR (>12um) applications. To explore the potential of this material system, we propose to investigate its use for detector device applications and demonstrate the predicted properties. Samples will be fabricated in a state-of-the-art MBE system using automated process control. We plan to study their dopant behavior and detector characteristics in a diode structure.

INTELLIGENT NEURONS, INC.
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Topic#: 93-011 ID#: 93-588
Office: BMDO
Contract #: DASG60-93-C-0095
PI: M.E. Ulug, PHD
Title: Electro-optical Fuzzy Pattern Recognition And Signal Processing
Abstract: The proposed innovation, a single stage, full duplex, electro-optical system, will improve and speed up the classification and signal processing of different types of patterns used by the sdi organization. When our electro-optical system used in the forward direction, it performs fuzzy pattern recognition by training all the classes in parallel. Simultaneously the same system can be used in the reverse direction to do bandpass and/or in-band filtering by processing a number of noisy input frames in parallel. In the past decade artificial neural networks have been used to classify patterns in many fields. However, problems have been encountered in intelligent systems, e.g., machine vision platforms that attempt to interpret scenes with various kinds of sensors and contextual information, by the incorrect classification of test patterns. Imagine an SDI pattern indicating three different signatures. The first one, however, is more pronounced than the other two. In such a case the neural network will identify the first signature because it achieved the minimum error for this particular class and ignore the other two. As a result, the expert system of the intelligent system will either fail to identify or wrongly interpret the situation and make the wrong decision. The use of fuzzy rather crisp classification can avoid these problems. We propose a novel method for providing optical modulator pads on silicon VLSI circuits. Our technique should enable modulator pad arrays of nearly arbitrary configuration, with minimum pad geometries of a few microns square. Modulator response times less than 1 ns should be achieved. The technique requires only a few process steps and will work on circuits made in any standard VLSI process.

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INTERSCIENCE, INC.
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Phone: (518) 283-7500
Topic#: 93-014 ID#: 93-448
Office: BMDO
Contract #: N00014-93-C-0113
PI: James Woo, PHD
Title: Pseudo-homoepitaxial Growth of Single Cell Diamond Films
Abstract: Heteroepitaxy of single crystal diamond films at low pressure by energy assisted chemical vapor deposition for electronic device applications is a goal that remains unrealized after more than a decade of efforts world wide. A fundamental problem is the lack of control on nucleation in the heteroepitaxy process. Recently, our organization has successfully demonstrated for the preparation of single crystal diamond substrates by a Regenerative Epitaxial Growth (REG) process. The exploration of an alternative technique, the Pseudo-Homoepitaxy Growth (PHG) process. That may be simpler to implement is proposed. The Phase I objective is to experimentally evaluate the feasibility of the critical steps in the process. Successful outcome will lead to availability of diamond substrates for the development of diamond based electronics.

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Topic#: 93-010 ID#: 93-375
Office: BMDO
Contract #: DASG60-93-C-0103
PI: Michael Kuperstein
Title: Automated Target Recognition & Surveillance Using Neural Networks
Abstract: Strategic defense systems need to develop Automated Target Recognition (ATR) sub-munitions that can identify friend or foe and for surveillance. Current ATR methods have problems classifying highly varying images of 3D objects. The proposed work aims to overcome some of these difficulties by building a neural network ATR system that learns by example. The objective of the proposed Phase I effort is to show proof-of-concept by classifying multiple toy airplanes in different lighting conditions and 3D orientations. The proposed effort will extend a working recognition product that has been shown to achieve extremely high accuracy in recognizing highly variable symbols. The neural classifier has been designed to use general features that are not specific to the class of objects being recognized. Its parallel architecture allows highly optimized processing speeds. It will tolerate internal noise, partial system damage and parameter drift. In Phase II of this project, the neural network ATR system will continue to be developed to demonstrate fast recognition of aircraft in the field.

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Topic#: 93-003 ID#: 93-742
Office: BMDO
Contract #: DASG60-93 C-0102
PI: Angel Pepe
Title: Megacube: Very Large Highly Interconnected FPA Technologies
Abstract: This proposal identifies the Ultra-Dense Micro Connector (UMC) bonding face. The UMC is plug-in-socket with a fuzz button base that creates a resealable, self-aligning, interconnector needed to build stacks of computer chips into the megacube. The megacube is the next step beyond hybrid mosaic on stacked silicon. By flipping computer stacks on their side and bonding them with other computer stacks, we are able to decouple their pitch from spacing in that area and create the megacube. With this construction, the megacube has true parallel bussing with lateral processing. The megacube significantly increases the processes per time and per area that can be done. This processor grouping can be adapted to incorporate computations at the sensor to increase the performance. Algorithms can be used in the output of such sensors.

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Phone: (714) 549-8211
Topic#: 93-011 ID#: 93-743
Office: BMDO
Contract #: N60921-93-C-0103
PI: David E. Ludwig
Title: High Density Inter-chip Optical Interconnect
Abstract: The individual chip input/output bottleneck has become a primary limitation on computing capability. The proposed innovation overcomes this bottleneck by optically coupling all of the nodes on one chip in parallel with all the nodes on the chips with which it communicates. The key ingredient is SDIO-sponsored university research into the fabrication of light emitting II-VI materials on silicon. Blue light emitted at a surface node is transmitted through the silicon substrate to a photo transistor

receiver on a chip to which the transmitting chip is laminated. The transmitting chip is thinned to 10 micrometers allowing the blue light to transmit through the chip but extinguishing it before it can reach neighboring nodes. The Phase I program will establish the compatibility of the light emitting processes with commercial CMOS fabrication and design a Phase II demonstration article and test plan.

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Topic#: 93-013 ID#: 93-142
Office: BMDO
Contract #: N00014-93-C-0154
PI: James Cornie, PHD

Title: Pressure Infiltration Cast Metal Matrix Composite Components

Abstract: The MIT developed pressure infiltration casting process results in near absolute net-shape components due to its inherent control of casting parameters, precision of tooling manufacturing, dimensional control of tooling, and the ability to fill thin sections in reinforced Al and Mg matrix components. The process is also attractive because of its ability to cast complex components from normally difficult to cast, but otherwise attractive alloys. However, the process is expensive due to the long cycle time. Proposed here is a high risk but potentially high pay-off approach to increasing the productivity of the process by a factor of 60 to 90. At this rate, the process will be more competitive than either squeeze casting or die casting. The principal Phase I objective is to decrease the cycle time from the current 3 hr to 6-10 min without sacrificing casting quality characteristic of the process. To accomplish this, we will investigate alternative processes that will increase the throughput of the casting machine and will determine if these processes can be scaled. We will also investigate methods for more rapid heat removal and for increasing the productive volume of a given pressure infiltration casting machine.

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Topic#: 93-013 ID#: 93-143
Office: BMDO
Contract #: N60921-93-C-0109
PI: James Cornie, PHD

Title: Interface Properties of Light Metal Composites through In-Situ

Abstract: Certain precipitation hardenable MMC matrix alloys display more rapid coarsening at fibermatrix interfaces than within the matrix. Upon axial loading, the precipitates serve as stress intensifiers in the plane of the interface. The interface is weakened by reducing the work of decohesion, WD. This enables the delamination toughening mechanism and composite strengths are greatly increased. Since the decrease in WD is related to the size and distribution of precipitates on the interface, WD can be specified and controlled through simple heat treatment, if we understand the kinetics of the interface coarsening process. We have demonstrated this effect and established kinetics in the Al-Cu system and have termed this phenomena the Discontinuously Coated Interface Effect (DCITM). Transverse and axial strengths can be substantially improved through heat treatment alone. The need for expensive fiber surface coatings are unnecessary. The principle objective of this program is to demonstrate this effect in interesting high temperature al matrix alloys and more complex ternary alloys that are age hardenable reinforced with alumina (nextel 610) fibers. Phase II will concentrate on exploration of more complex alloys, detailed kinetic studies of highly promising compositions and the establishment of a data base for promising systems.

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Topic#: 93-003 ID#: 93-725
Office: BMDO
Contract #: DASG60-93-C-0119
PI: Bret Halpern, PHD

Title: "Segmented" Solid Host Dye Lasers

Abstract: To date, candidate host materials, such as plastics and SOL-GEL glasses, as well as methods of host fabrication employing them, have not proven optimal. They require conversion of a dye-doped liquid precursor to the final solid host; we propose an alternative fabrication approach based on vapor deposition and exploration of other materials. High quality thin glass plate or optical fiber "segments" will be coated with a dye-doped ceramic thin film; the plates or fibers will be assembled into a stack or fiber bundle which comprises the solid dye laser. In Phase I we will use JVD to deposit rhodamine 6G-doped ceramic films on glass slides and silica optical fibers; these will be assembled into solid host dye lasers and tested for laser action and photodegradation.

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Phone: (203) 786-5130
Topic#: 93-014 ID#: 93-670
Office: BMDO
Contract #: N00014-93-C-0156
PI: Bret L. Halpern
Title: Low Temperature Microwave Plasma-assisted Jet Vapor Deposition
Abstract: Jet Vapor Deposition (JVD) incorporating microwave sources and plasma treatment of the substrate is a promising method for depositing silicon nitride and silicon dioxide. The technique offers controllable rates of deposition, low deposition temperature and high potential throughput. The patented JVD process also generates a minimal quantity of toxic waste products, in contrast to many CVD processes. Study of the plasma mechanisms involved will pinpoint the factors that give rise to high quality dielectric films having electronically good interfaces with silicon. The stability of JVD films and their interfaces under thermal processing will be evaluated. If favorable, the JVD dielectrics will be integrated into advanced, high density silicon device processing. JVD dielectrics may also be applied in semiconductor technologies that do not use high temperatures (>700 degrees C) encountered in silicon processing, such as the III-V and II-VI compounds. JVD also has potential in the deposition of metal layers for device fabrication due to its economical use of source material and high throughput.

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Topic#: 93-014 ID#: 93-017
Office: BMDO
Contract #: DASG60-93-C-0097
PI: Shambhu K. Shastry
Title: Aluminum-free Compound for Stable Heteroepitaxial Materials
Abstract: Materials lasers aluminum-free heteroepitaxial silicon III-V's Kopin Corp will desensitize the deleterious impact of the inherent defects in heteroepitaxial films formed on silicon i.e., by the selection and use of "aluminum-free" substitute materials with suitable properties. Evidence exists that such Al-free compounds offer the prospect of using materials with a relative immunity to the defects that occur in lattice mis-matched films. In Phase 1, GaInP/GaAs lasers will start with materials, emphasizing a correlation between material properties, defect structure and potential device performance. This makes possible ultra high speed electro-optical III-V devices such as lasers used for advanced communications.

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Phone: (716) 688-8251
Topic#: 93-013 ID#: 93-737
Office: BMDO
Contract #: N00014-93-C-2136
PI: Ryszard Burzynski, PHD
Title: Wear Resistant Ceramic Coatings
Abstract: The innovation we propose in the Phase I work is the development of novel and inexpensive route to pure ceramic coatings exhibiting well documented corrosion and wear resistance. The proposed effort will establish feasibility of formulating pure phase ceramic coating and explore the potential of fabricating multiphase and/or multicomponent coatings with controllable microstructure. It is anticipated that the proposed route will yield cost-effective high temperature, stable, and easily processed ceramic coatings exhibiting excellent adhesive, corrosion and wear resistance properties.

LAWRENCE SEMICONDUCTOR RESEARCH LABS
2300 HUNGINGTON DRIVE
TEMPE, AZ 85282
Phone: (602) 438-2300
Topic#: 93-014 ID#: 93-557
Office: BMDO
Contract #: N00014-93-C-0114
PI: McDonald Robinson
Title: SIGEC Heteroepitaxial Layer Growth By Low Temperature, High Purity
Abstract: The goal of the proposed research is to develop a process grow device quality Si-Ge-C strain layers heteroepitaxially onto single crystal silicon substrates. Si-Ge-C alloys will make possible a new class of heterojunction devices in which the bandgap can be tailored to be wider or narrower than silicon, and in which partial or complete strain compensation is possible. Initial process development will be at the University of California at Davis in a prototype ultra-high vacuum chemical vapor deposition reactor with purified gas sources. Since carbon must be incorporated into silicon in excess of its solubility limit, deposition will be at the lowest possible temperature, <700 degree. Properties will be measured and deposition parameters varied to optimize the layers. The deposited layers will be characterized by optical microscopy, SEM, TEM, AES, high

resolution XRD, SRP, photoluminescence and photoabsorption. When initial process conditions have been established in the UHV/CVD system, a parallel development will be started at Lawrence Semiconductor Research Laboratories (LSRL) using an Epsilon One, single wafer automated CVD reactor. The Epsilon One also operates with high purity gas sources, and has previously demonstrated Si-Ge epitaxial layer growth at temperatures as low as 600°C. The ultimate goal is to establish LSRL as a supplier of custom Si-Ge-C heterostructures to commercial customers and to government contractors and agencies.

LINARES MANAGEMENT ASSOC., INC.
93 WEST TECH CENTER
MEDFIELD, MA 02052
Phone: (508) 653-5458
Topic#: 93-014 ID#: 93-468
Office: BMDO
Contract #: F33615-93-C-1274
PI: Robert Linares
Title: Improved Substrates For GaN and AlN Films
Abstract: Gallium Nitride (GaN) and Aluminum Nitride (AlN) films are currently grown on substrates with substantially different crystal structures and atomic spacing. Films grown on such substrates have poor crystallographic properties which result in degradation of electrical properties and device performance. Improved substrate materials are required which will permit the growth of perfect films of GaN and AlN. The full potential for UV lasers, blue leds, detectors and high frequency devices will be more readily met with these improved films. As in the case of silicon and gallium arsenide, the availability of improved substrates is expected to result in a significant advance in the performance of all these devices. The proposed program is expected to lead to a manufacturing process for both improved substrates, and to high quality GaN and AlN films for device fabrication.

MATERIALS MODIFICATION, INC.
2929 ESKRIDGE ROAD
FAIRFAX, VA 22031
Phone: (703) 560-1370
Topic#: 93-001 ID#: 93-498
Office: BMDO
Contract #: DASG60-93-C-0121
PI: A.P. Malshe
Title: Ultrasmooth Finishing Of Optics
Abstract: Optics used in sensors or missile systems are made from sapphire, or silicon carbide because of their excellent optical or insulating properties, their inert, and their ability to resist harsh environments. Polishing sapphire by mechanical or mechanochemical methods induces residual damage and limits the overall surface roughness (usually around 1 microinch). This roughness produces scattering centers that affect the performance of the optics. Further, polishing of large areas and contoured surfaces using mechanical or mechanochemical methods is both time consuming and expensive. Thus, a high speed moderate cost technique that can polish optical materials with minimum damage is desired. A novel, low cost laser polishing method is proposed in this Phase I that will produce ultrasmooth sapphire surfaces. This technique has the capability to be adapted for contoured surfaces and can also be used in combination with intelligent manufacturing systems. The Phase I effort will establish the feasibility of polishing sapphire substrates using a unique laser method. The follow on Phase II will be devoted to polishing large complex geometries that can be characterized and field tested in several optical applications.

MATERIALS TECHNOLOGIES CORP.
57 MARYANNE DRIVE
MONROE, CT 06468
Phone: (203) 874-3100
Topic#: 93-014 ID#: 93-533
Office: BMDO
Contract #: F33615-93-C-1275
PI: John Pike
Title: Far Infrared Qw Detector
Abstract: Surveillance in the infra-red part of the electromagnetic spectrum demands innovative concepts to design Quantum Well (QW) detectors for wavelength beyond 12 um. The requirement for low tunneling current and superior transport properties make InAs-In(x)Ga(1-x)Sb, a type II superlattice, a suitable candidate for infra-red application. Strain induced band gap variation and wavelength controllability using superlattice period enables one to use this system over a wavelength range of 4-24 um. A reduction in shot noise using double-periodic superlattice will enable to realize a large signal to noise ratio. Moreover, the scheme employed to reduce shot noise will result in an enhanced absorption coefficient making possible the realization of a detector with a large signal to noise ratio.

MAXDEM, INC.
140 E. ARROW HIGHWAY
SAN DIMAS, CA 91773
Phone: (909) 394-0644
Topic#: 93-014 ID#: 93-079
Office: BMDO
Contract #: DASG60-93-C-0063
PI: Virgil Lee
Title: Polyguinoline Dielectrics as Low Dielectric Packaging
Abstract: Polyquinoline dielectrics as low dielectric constant packaging materials offer many advantages over other organic polymers (eg. polyimides) and inorganic materials. Key properties include low dielectric constant (2.6-2.8), very low moiture uptake (0.15%), And high thermal stability. Many electronics applications require photoimageable dielectrics and in most applications fabrication is simplified with the use of photoimageable polyquinoline for electric applications. Advanced packaging systems such as Multi-Chip Modules (MCM's) now relying on expensive plasma etching techniques could switch to low cost wet etchable polyquinolines. Wet etch methods are prevalent in Japan but almost non-existent in the U.S. It is imperative that U.S. MCM producers develop wet etch techniques in order to compete with lower cost products from overseas.

MAXDEM, INC.
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Phone: (909) 394-0644
Topic#: 93-014 ID#: 93-212
Office: BMDO
Contract #: N00014-93-C-0190
PI: Ying Wang, PHD
Title: Polymer Dielectrics for Electronics
Abstract: We propose to develop a new series of advanced polymeric materials for a wide variety of electronics applications. These novel branched polymers will be prepared from low cost starting materials and will have low dielectric constant and high thermal stability. Polymers with superior electrical, thermal and mechanical performance are critical for advanced packaging of electronics including Printed Wiring Board (PWB) and Multichip Module (MCM) dielectrics for integrated circuits, passivation layers, Liquid Crystal Display (LCD) orientation layers, LCD color filters, dielectrics for capacitors and wire coating, and essentially wherever electrical insulation is needed. The chemical reactions to make these new polymers have already been established under programs at MAXDEM directed towards structural resins. We propose here to use this chemistry to prepare polymers with structures specifically designed for the needs of electronics applications.

MEL TECHNOLOGIES
PO BOX 454
TOPSFIELD, MA 01983
Phone: (508) 887-2850
Topic#: 93-003 ID#: 93-182
Office: BMDO
Contract #: DASG60-93-C-0125
PI: Gary Viviani
Title: Electromagnetic Signal Detectors from Multi-Stable Devices
Abstract: This research will develop an ultra fast scheme for detection of electromagnetic signals based on the inherent elliptical symmetry of multi-stable devices, as proposed by SAET and VIVIANI. The result is a state space mapping which can be usefully applied for real-time detection, control and monitoring for a variety of signals of interest, by developing suitable hardware based on a novel generalized polarization concept (which is also described). This proposal plans to draw upon a body of literature on the subject of multi-stable devices in order to provide plans for commercially viable technology based on the invention of the principal investigator. Likely applications include: radar backscattering, observations of optical "objects of interest," ocean acoustic monitoring and a host of others. Such results should be of significant interest for applications where approximations to "vision" are desirable, and as ought to be expected with a fundamental advance such as this, the procedures are applicable across the frequency spectrum. As compared with conventional approaches, the primary motivation for this approach is ultra-fast performance that results from the requisite dynamical properties of a multi-stable device.

MERIX CORP.
77 CHARLES STREET
NEEDHAM HEIGHTS, MA 02194
Phone: (617) 455-8877
Topic#: 93-005 ID#: 93-436
Office: BMDO
Contract #: F33615-93-C-2310
PI: Thomas Mix, PHD
Title: High Flux Heat Transfer System
Abstract: High power electronics devices such as power switches generate large heat fluxes, which must be removed, or the devices will exceed their upper temperature limits. Most cooling methods are incapable of removing such large heat fluxes.

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Merix Corporation proposes to develop a high efficiency cooling device to remove these heat fluxes in a practical manner. The device will form the backbone of an integrated thermal management system for high power circuits.

MICRACOR, INC.
43 NAGOG PARK
ACTON, MA 01720
Phone: (508) 263-1080
Topic#: 93-003 ID#: 93-520
Office: BMDO
Contract #: DASG60-93-C-0062
PI: J.A. Keszenheimer
Title: Multisegmented Semiconductor High Power Lasers
Abstract: Semiconductor lasers with high power and good spatial-mode quality are useful for many applications in materials processing and laser radar. Commercial high power semiconductor lasers are limited in output power due to catastrophic degradation at the output facet, and require beam-shaping optics to correct for beam asymmetries and large divergence angles. Optical pumping of semiconductor material allows for greater flexibility in pumping schemes and permits good control of transverse mode quality to achieve excellent, circularly symmetric beam quality. In a multiple-element design, output power can potentially scale to levels >100 w average and >5 kw peak. This results in a capability not yet realized with commercial semiconductor lasers.

MICRACOR, INC.
43 NAGOG PARK
ACTON, MA 01720
Phone: (508) 263-1080
Topic#: 93-014 ID#: 93-515
Office: BMDO
Contract #: N00014-93-C-0185
PI: J.A. Keszenheimer
Title: Solid-state Waveguide Lasers
Abstract: Diode-pumped solid-state lasers have the advantage of being all-solid-state devices with overall efficiencies of several percent and long operating lifetimes, single-mode solid-state lasers are useful for a number of applications ranging from communications to laser radar. High average power operation requires extensive cooling of the laser crystal to prevent thermal degradation of the beam. Solid-state waveguide lasers can achieve high average power, single-mode output with good conversion efficiency and efficient heat dissipation. In the devices proposed here, a TEM mode propagates in a waveguide structure with a crossectional dimension of hundreds of wavelengths. The waveguide allows efficient absorption of pump radiation and good mode overlap with the pump. High power waveguide lasers have inherent advantages over conventional diode-pumped solid-state lasers in terms of power scalability, low manufacturing costs, robustness and reliability.

MITCHELL/STIRLING MACHINES/SYSTEMS
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BERKELEY, CA 94710
Phone: (510) 845-2528
Topic#: 93-003 ID#: 93-282
Office: BMDO
Contract #: F29601-93-C-0110
PI: Matthew P. Mitchell
Title: Two-stage Sibling Cycle Compressor/Expander
Abstract: A compact two-stage sibling cycle compressor/expander combining the simplicity of the pulse tube with the performance of the linear stirling is proposed for use in cryocoolers. The Phase I objectives will be to fabricate and install the second stage, and to model and plan a cryocooler incorporating a linear-driven two-stage sibling cycle compressor/expander to be built and tested in Phase II. The goals for Phase II are to design and built a cryocooler incorporating a two-stage sibling cycle compressor/expander and a linear drive. Performance goals are first-stage temperature of 75 K and a second-stage temperature of 30 K. Modeling of a single-stage cryocooler with sibling compressor/expander indicates adequate refrigeration to achieve those goals.

NANOPHASE TECHNOLOGIES CORP.
8205 S. CASS AVE., SUITE 105
DARIEN, IL 60561
Phone: (708) 963-0282
Topic#: 93-014 ID#: 93-294
Office: BMDO
Contract #: N00014-93-C-2135
PI: John C. Parker
Title: Nanophase Metal Oxides for Electroceramic Sensor
Abstract: Many of the commercial sensors in use (or under development) are based in metal-oxide ceramic materials.

Metal-oxides offer special advantages because of their chemical and thermal stability, fast response times, and sensitivity to electrochemical changes. There are reported cases that show adsorption of water in metal oxides often enhancing both the surface conductivity and dielectric properties of the material. It has become possible in recent years to engineer bulk metal-oxide ceramics via the formation and assembly of Gas-Phase Condensed (GPC) clusters. Although the synthesis of these "nanophase" metal-oxides is fairly new, Nanophase Technologies Corporation (NTC) sees a unique opportunity for the use of these materials in improved sensors and non-linear electronic devices. NTC is the leading U.S. Commercial producer of GPC nanophase ceramics. In the proposed Phase I work, the properties that can be obtained with a nanophase materials for specific electronic sensor device applications will be made in Phase II.

NEILLEN TECHNOLOGIES CORP.
PO BOX 910
LANHAM, MD 20703
Phone: (301) 805-7266
Topic#: 93-016 ID#: 93-291
Office: BMDO
Contract #: DASG60-93-C-0090
PI: Richard Lavigne
Title: Inductorless Technology for RF Integrated Circuits
Abstract: Neillen Technologies Corporation (NTC)'s inventions are based on the unique linear and non-linear modeling of bipolar/unipolar active RF components, which produces advanced RF circuits not requiring traditional coils and transformers for tuning and matching functions. NTC's circuits are distinguishable because they: 1) significantly outperform conventional RF circuits (in many instances, by orders of magnitude); 2) are more cost-effective than conventional RF circuits (since they are low-power, low-noise, small-size, and reproducible); 3) perform new functions throughout the frequency spectrum (thus allowing new applications); 4) may be reduced to monolithic Integrated Circuits (ICs) -- a first in the RF electronics manufacturing industry. Ntc proposes tasks for the analysis, engineering, and bread-board modeling of six inductorless RF circuits: ultra-stable/"ageless" oscillators, Voltage-Controlled Oscillators (VCOs), tuned amplifiers, tuned bandpass filters, harmonic generators, and capacitive mixers.

NOVEX CORP.
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COSTA MESA, CA 92626
Phone: (714) 966-9377
Topic#: 93-014 ID#: 93-692
Office: BMDO
Contract #: DASG60-93-C-0093
PI: David Pelka, PHD
Title: Wide-band, Highly Conjugated, Non-centrosymmetric Guest/host
Abstract: Novex Corp. proposes to develop a guest/host polymer system using highly conjugated Non-Centrosymmetric (HCNC) molecules as the guest on a photo-lime gel polymeric matrix. The features of this approach will be 1) a Graded Index (GRIN) profile which will allow us to construct guided wave NLO device on any substrate of interest (e.g., PC board, GaAs, Si, N(2)O(3) LiNbO(3), etc.), 2) excellent optical clarity from 300 nm to > 700 nm which will allow us to make low insertion loss NLO active and passive devices in UV, visible and near IR, and 3) highly polarized vacant sites within the host polymer which will allow us to implement an array of HCNC molecules to construct a number of new guest/host NLO polymers. Much faster switching time than inorganic NLO devices is projected. The fabrication process promises to be easy and cost-effective. As a result high quality and low cost NLO material is expected.

OBITAL TECHNOLOGIES CORP.
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MADISON, WI 53719
Phone: (608) 833-1992
Topic#: 93-007 ID#: 93-771
Office: BMDO
Contract #: F33615-93-C-2345
PI: Dr. Eric E. Rice
Title: Magnetic Fluid Experiment
Abstract: The storage of liquid cryogens in zero-g conditions with minimal cryogen loss and high delivery rates has been recognized as an essential requirement in space applications for many years. The suggestion in this invitation to consider a storage system that utilizes the magnetic properties of the cryogenic fluid. Many approaches have been explored to overcome the zero-g problem, such as artificial gravity, liquid acquisition devices, physical separation devices, and porous plugs. But the methods proposed by orbitec are of less complexity and much higher reliability. By knowing the location of the liquid and gas phases the four basic functions associated with cryogenic storage and transfer are greatly simplified. The four basic functions include, supply of single phase fluids, pressure and flow control, resupply, and gauging. By using the magnetic properties of

the cryogenic fluid, where liquid oxygen is imparting a magnetic field to the fluid in a dewar. The use of magnetic properties is now a potential with the advent of relatively new and powerful rare earth Magnetic Expulsion Dewar (MED) for use with liquid hydrogen will potentially have all the benefits of the mid. The most important factor in determining feasibility for use with a hydrogen system is how comparatively lower diamagnetic hydrogen and surface tension forces will behave in zero-g.

ONYX OPTICS
3430 BYRON COURT
PLEASANTON, CA 94588
Phone: (510) 490-1880
Topic#: 93-014 ID#: 93-198
Office: BMDO
Contract #: N00014-93-C-2101
PI: Helmuth Meissner
Title: Diode Pumped Solid State Crystalline Composite Lasers
Abstract: Modeling data at the Naval Research Laboratory (NRL) have demonstrated that efficiency and beam quality of side-pumped laser diode-pumped CTH:YAG laser rods at high repetition rates are improved by applying a laser-inactive cladding around the periphery of the lasing medium and end caps for ficturing the rod into the cavity. Onyx Optics has developed a technique to prepare diffusion-bonded composites of laser-active and laser-inactive YAG single crystals. This proposal for Phase I encompasses fabrication of functional clad CTH:YAG rods with octagonal cross section by diffusion bonding cladding strips to the core of the lasing medium and subsequent attachment of undoped end sections to the clad rod. Lasing performance of these composite rods will be evaluated at NRL. We also propose to determine experimental process parameters such as growth patterns of crystalline islands as function of relative crystallographic orientation at the interface. Thermal shock resistance of conventionally and acid polished composite rod couples will be compared with non-bonded controls. Potential applications of composite cth:yag lasers for the strategic defense initiative organization include active illuminators of increased repetition rates and lower thermal distortions, operating in the almost-CW regime.

OPTICAL CONCEPTS, INC.
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LOMPOC, CA 93438
Phone: (805) 737-7391
Topic#: 93-011 ID#: 93-637
Office: BMDO
Contract #: DASG60-93-C-0048
PI: M. Kevin Kilcoyne
Title: High Speed Optical Transmitter
Abstract: Laser bandwidths are presently limited by the small differential gain coefficient of the bulk material. This proposal describes a technical approach which will overcome these limitations and allow fabrication of lasers with modulation bandwidths well beyond 25 GHz. The approach takes advantage of the smaller dimensions of Vertical Cavity Surface Emitting Lasers (VCSELs) which result in increased relaxation oscillation frequency and significantly improved damping of the response. These limitations in VCSELs are significantly improved over those in in-plane lasers. A resonance frequency per square root coefficient of 7.6 GHz per square root milliwatt has been determined using relative intensity noise measurements, and a maximum relaxation oscillation frequency of 71 GHz was observed by streak camera measurements, on an 8 micrometer square VCSELs Since this performance was obtained at 980 nm wavelengths, the goal of this effort is to develop 830, 1310 and 1550 nm VCSELs with similar or improved high frequency performance.

OPTIGAIN, INC.
46 CARRIAGE LANE, PO BOX 1668
KINGSTON, RI 02881
Phone: (401) 783-9222
Topic#: 93-011 ID#: 93-611
Office: BMDO
Contract #: N60921-93-C-0099
PI: Steven Bastien, PHD
Title: Optimized And Low Cost Praseodymim-doped Fluoride Fiber Optical
Abstract: We propose to develop optimized, high performance and low cost fiber optical amplifiers for use in the 1300 nm signal wavelength. We plan to show the feasibility of our approach by carrying out measurements in an assembled laboratory set-up. We will compare these results with our theoretical predictions with a computer model, called medal. This model has proven accurate with our work on Erbium-Doped Fiber Amplifiers (EDFAs). Predictions can then be made on the expected performance in the Phase II prototypes to be developed. The uniqueness of our approach is the use of (I) novel pump reflecting mirror configurations with (II) fairly short lengths (6 m) of high numerical aperture, and highly doped, Pr-doped fibers, (III) optimized singlemode designs for fabricating the 1017/1310 nm wavelength division multiplexers, and (IV) the eventual use, in Phase II, of newly develop high power (1w) Master Oscillator Power Amplifier (MOPA) semiconductor laser structures. These are the

first devices which seem adequate for developing commercial PDFFOAS with high gain and low cost. With these devices and our unique approach, we believe that the performance and cost of PDFFOAs will be comparable to that of EDFAs for the first time.

OPTOELECTRONIC DATA SYSTEMS
310 SOUTH 42ND STREET
BOULDER, CO 80303
Phone: (303) 494-2076
Topic#: 93-011 ID#: 93-685
Office: BMDO
Contract #: N00014-93-C-0148
PI: Robert Weverka
Title: Hybrid Electro-optical Resonator For Image Classification
Abstract: We propose to build a hybrid electrical-optical resonator which retains the large number of independent reference objects of the all-optical systems, but scale to much higher speeds, and performs shift-invariant recognition. The large number of independent references are stored in volume hologram as angualry multiplexed holograms. Shift invariance is accomplished by using these reference image as one of the inputs to a correlator, the other input being the image to be recognized. Speed is obtained by restricting the dynamic variable to power levels whose temporal change is influenced only by electrical and acoustooptic time constants and not by photorefractive or spatial light modulator time constants. This allows the system to perform classification of the microsecond time scale rather than the millisecond scale required of the all-optical approach.

OPTRON SYSTEMS, INC.
3 PRESTON COURT
BEDFORD, MA 01730
Phone: (617) 275-3100
Topic#: 93-011 ID#: 93-674
Office: BMDO
Contract #: N60921-93-C-0094
PI: James E. Hubbard, Jr.
Title: Dynamic Focusing Mirror Array For Writing/reading 3-D Memories
Abstract: This Phase I proposal is concerned with the development of a versatile write/read interconnection device for bit and holographic encoded memories. The proposed device consists of an array of mirrors whose focal lengths can be individually controlled by a VLSI chip consisting of a 2-D array of identical drive circuits. The VLSI chip is bump-bonded to the one side of an Optron proprietary component called a Charge-Transfer Plate (CTP) and a membrane mirror is bonded to the other side of the CTP over an array of pixel wells. The role of the CTP is to transfer the voltage from the VLSI chip to the membrane wells. In the Phase I program we plane to fabricate a prototype device having 25 um diameter mirror on 30 um centers and attempt to demonstrate electrically varying the focal lengths of the mirrors from infinity to above 1 cm. We will further characterize the device by measuring spot sizes as a function of the focal length of the mirrors, focal length as a function of addressing voltage, and the optical efficiency of the array. The measurements will be correlated with calculated values.

OPTRON SYSTEMS, INC.
3 PRESTON COURT
BEDFORD, MA 01730
Phone: (617) 275-3100
Topic#: 93-011 ID#: 93-681
Office: BMDO
Contract #: N00014-93-C-2137
PI: James E. Hubbard, Jr.
Title: Paraelectric Liquid Crystal Spatial Light Modulator Structures
Abstract: There are no Spatial Modulators (SLMs) available that offer high framing rate (MHz), variable gray scale, high contrast, and low-voltage operation simultaneously. Based on preliminary experiments conducted at the Naval Research Laboratory, it appears that a solution to this problem could lie in paraelectric liquid crystals that exhibit the electroclinic effect. We therefore propose in this Phase I program to collaborate with researchers at NRL who are synthesizing such SMECTIC-A paraelectric liquid crystals, and explore the electrical, thermal, and light modulation properties of these materials in simple SLM structures. It is expected that the SLM built in the Phase I program will demonstrate framing speeds on excess of 1 KHz, contrast ratios of about 100:1, and at least 6 bits of gray scale in the Phase I program.

PACASTRO, INC.
520 HUNTMAR PARK DRIVE, SUITE 100A
HERNDON, VA 22070
Phone: (703) 709-2240
Topic#: 93-006 ID#: 93-097
Office: BMDO
Contract #: DSAG60-93-C-0092
PI: Rick Fleeter

Title: Mission Flexible, Low Cost, Suborbital Launch Vehicle
Abstract: Lack of reliable, flexible, low cost transportation for small payloads is a bottleneck in the development and deployment of space based systems. Pacastro's family of rocket vehicles, employing a core pressure-fed, liquid propulsion unit and electronics and software technology developed in small low cost spacecraft programs, will cut in half the price of launching small suborbital and orbital payloads. Our development program follows a gradual, stepwise plan. In the proposed program we will demonstrate the design, cost and performance of the sub-orbital PA-1 vehicle with very high confidence and fidelity. Major results will be a PDR level design package, a user manual, detailed costing and a 1:10 scale model. Like all Pacastro vehicles, PA-1 employs environmentally benign liquid propellants, its 60" diameter payload bay easily accommodates large payloads and co-manifesting multiple smaller payloads and uses flight proven components PA-1 performance is comparable to the largest suborbital rockets, but it requires only a single, simple stage. It's trajectory, fully controlled in software, can be tailored to each mission, including executing multiple payload injections into different trajectories. PA-1 eliminates the need to maintain multiple suborbital rockets and to carefully control payload mass and balance. Successful completion of the proposed project will lead to a flight demonstration program of the PA-1 suborbital rocket under the planned next phase of the program.

PATHFINDER SYSTEM, INC.
274 UNION BLVD., SUITE 430
LAKEWOOD, CO 80228
Phone: (303) 763-8660
Topic#: 93-010 ID#: 93-369
Office: BMDO
Contract #: DASG60-93-C-0089
PI: Robert T. Reed
Title: High Speed Artificial Neural Network Defense
Abstract: High-speed artificial neural nets are applied in multiple layers as part of a hybrid architecture to the decision aiding functions of the battle management segment of a strategic defense command and control system. The project will include demonstration of two early prototypes in Phase I. These serve to facilitate definition of requirements and preliminary design of a prototype Phase II technology demonstrator. The artificial neural net technology used is capable of extremely high-speed decision generation. Our approach separates the mechanics of learning from the mechanics of generating decisions. The computational complexity of the approach is minimal. We have demonstrated generation of complex tactical decisions in approximately 10 milliseconds using a personal computer in our earlier work in this area. Use of the "learning" features of our proposed decision aiding system will require no special skill or training on the part of the human who takes on the task of teaching the system. The primary objective of our proposed research will be to demonstrate the usefulness of high-speed artificial neural nets, embedded in a multi-loop architecture to support battle management decision aiding in a strategic defense command and control environment.

PDR, INC.
54 ADAMS STREET
FOXBORO, MA 02035
Phone: (508) 543-4052
Topic#: 93-003 ID#: 93-093
Office: BMDO
Contract #: DASG60-93-C-0123
PI: Kenneth G. Preston
Title: Snap-Together Optical System
Abstract: PDR and Aerojet have jointly developed a unique and novel optical design for generating a high performance, low cost, snap together optical system. This state of the art concept features a patent pending monolithic plate which is used in the well recognized 3-mirror optical telescopes. It allows for the primary (mirror 1) and tertiary (mirror 3) to be fabricated on a common plate using single point diamond turning technology. The concept, design, fabricated and qualified infrared optical telescopes were presented at the April 1992 SPIE Conference in Orlando FL. The next proposed evolution of this concept is to design an ultra-lightweight optical train, from one of three desirable materials; cast aluminum, SXA or silicon carbide, while maintaining its high performance, ruggedness and low cost optics that can be used in harsh environments (Cryogenic, Space, UGT, AGT, etc.) and having a broad spectral range from visible to infrared.

PHOTONICS RESEARCH, INC.
4840 PEARL EAST CIRCLE, SUITE 200W
BOULDER, CO 80301
Phone: (303) 541-9292
Topic#: 93-011 ID#: 93-365
Office: BMDO
Contract #: DASG60-93-C-0082
PI: Jack L. Jewell
Title: Micro-optic Hybrid Lens Based Optical Interconnects

70

Abstract: We will develop a revolutionary optical technology to enable competitive performance (terabit/sec communication bandwidth) and costs in optoelectronic computing systems. The basis of this technology is to combine conventional macro-optics with micro-optics in a single system to form a hybrid lens system. The hybrid system will have the advantages of both macro- and micro-optic technologies, thereby making the optical systems practical for optical interconnections between electronic chips or arrays of optical logic gates. In Phase I we will: 1) survey a variety of optical interconnection architectures, choosing two of them for in-depth studies; 2) design and evaluate conventional macro-lens systems for these architectures; 3) design and evaluate corresponding hybrid lens systems, 4) compare the performances of the systems and evaluate their relative manufacturabilities; and 5) report our results and prepare a Phase II plan to fabricate hybrid lens systems to be implemented into an optical interconnection demonstration. The technology developed will impact optical interconnects, optical computers, optical storage, detector arrays, machine vision, medical instrumentation and many other large-market military and commercial applications.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 530-1416
Topic#: 93-011 ID#: 93-331
Office: BMDO
Contract #: N60921-93-C-0111
PI: Vladimir Katsman, PHD
Title: Adaptive Bit Error Rate Measurement System
Abstract: Physical Optics Corporation (POC) proposes a new Bit Error Rate (BER) Adaptive Measurement System (BER AMS) that avoids common BER measurement errors. There are currently a number of BER measurement systems on the market which focus primarily on low speed communications, up to the OC-3 standard (155 MHz). Unfortunately, these systems are not adaptable to higher speed (> 1 GHz) communication system, resulting in erroneous BER measurements for higher data speeds in fiber optic transmission lines of up to two orders of magnitude. This means that the BER measurement systems currently available on the market will not be able to meet the needs of high speed (> 1 GHz) communications systems. Especially effected are high speed fiber optic data communication links which use different types of alphabet codes. POC's adaptive BER measurement system provides a solution to this problem. The BER AMS provides a more reliable data comminication testing method which is essential for the future development of high-speed military systems using different codes and high speed communication highways.

PHYSICAL OPTICS CORP.
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TORRANCE, CA 90501
Phone: (310) 320-3088
Topic#: 93-011 ID#: 93-409
Office: BMDO
Contract #: N00014-93-C-0136
PI: Lev Sadovnik
Title: MMW For Agile Beamsteering And Beamforming
Abstract: Physical Optics Corporation (POC) proposes a semiconductor mask that can impose a desired beam pattern on a Millimeter Wave (MMW) field and can quickly change it, offering a simple substitute for a phased-array antenna. Based on the principles of computer-generated holography, either a transmittance or reflectance pattern can be calculated that, when interacting with a MMW beam, will generate a desired far-field distribution. This pattern, in turn, can rapidly be imposed, erased, and rewritten by light alone, producing agile beamsteering and beamforming, quite difficult to achieve for millimeter waves. Since the spatial resolution required for MMWs is much lower than that obtainable by light, accurate and continuously variable beam formation becomes possible. In contrast to conventional phased array antennas, the proposed design uses an amplitude-only mask pattern. Such a continuously distributed MMW antenna pattern eliminates the need for individual phase shifters that increasingly jeopardize MMW packaging design above 60 GHz. In this project, POC will demonstrate the ability of a light-controlled semiconductor wafer to modulate a MMW field. Preliminary calculations show the feasibility of this concept, which will be applied to the design of a compact, agile MMW antenna controlled by light.

PHYSICAL OPTICS CORP.
20600 GRAMERCY PLACE, SUITE 103
TORRANCE, CA 90501
Phone: (310) 320-3088
Topic#: 93-011 ID#: 93-671
Office: BMDO
Contract #: N00014-93-C-0135
PI: Andrew Kostrzewski, PHD
Title: Optoelectronic System For Distortion-Invariant ATR

Abstract: Physical Optics Corporation (POC) proposes the development of a rotation-, scale-, and shift-invariant Automatic Target Recognition (ATR) system. The system will contain three subsystems: an electronic preprocessor for data enhancement and compression; a distortion-invariant optical feature for scale-, shift-, and rotation-invariant target representation: and an artificial neural network for final target classification. The electronic preprocessor will use nonlinear processing operations such as pyramidal and morphollogical filtering. The optical distortion-invariant feature extractor is based on a phase-coding scheme for fast processing. At the end of the Phase I project, a complete design of the proposed system of the optical feature extractor will be delivered. The proposed system will be highly rugged, portable, and robust, capable of performing real-time ATR operations for low signal-to-noise ration images. Optics used in sensors or missile systems are made from sapphire, or silicon carbide because of their excellent optical or insulating properties, their inert, and their ability to resist harsh environments. Polishing sapphire by mechanical or mechanochemical methods induces residual damage and limits the overall surface roughness (usually around 1 microinch). This roughness produces scattering centers that affect the performance of the optics. Further, polishing of large areas and contoured surfaces using mechanical or mechanochemical methods is both time consuming and expensive. Thus, a high speed moderate cost technique that can polish optical materials with minimum damage is desired. A novel, low cost laser polishing method is proposed in this Phase I that will produce ultrasmooth sapphire surfaces. This technique has the capability to be adapted for contoured surfaces and can also be used in combination with intelligent manufacturing systems. The Phase I effort will establish the feasibility of polishing sapphire substrates using a unique laser method. The follow on Phase II will be devoted to polishing large complex geometries that can be characterized and field tested in several optical applications.

PHYSICAL OPTICS CORP.
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Topic#: 93-014 ID#: 93-690
Office: BMDO
Contract #: DNA001-93-C-0093
PI: Robert Shih, PHD

Title: Radiation Hardened Integrated Optic Photodetector

Abstract: Physical Optics Corporation proposes to fabricate an extremely high speed (picosecond) and high sensitivity integrated optic photodetector. This detector is immune to any electromagnetic pulse is pigtailed to optical fiber for high speed information transfer to a radiation free location. The proposed device incorporated the novel bandgap engineered superlattice structure of a heterojunction bipolar phototransistor in combination with an integrated optic waveguide interferometer. POC's device provides a natural high speed operation due to its vertical structure, large current density for high sensitivity operation, and high transconductance (GM) for high current gain. The device is integrated with an optical three guide coupler mach-zehnder interferometer to transport the detector information by light. The photo-generated emitter-to-collector current generates a change in the index of refraction of one arm of the interferometer and therefore changes the light intensity at the output. POC will bridge the gap between high speed semiconductor devices and integrated optics by building this highly integrated photodetector.

PICOTRONIX, INC.
PO BOX 130243
ANN ARBOR, MI 48113
Phone: (313) 763-4881

Topic#: 93-014 ID#: 93-551
Office: BMDO
Contract #: N00014-93-C-0139
PI: Steven L. Williamson

Title: 1-picosecond InGaAs Photodetector for Operation at 1300-1600 nm

Abstract: The objective of this proposal is to develop a 1-picosecond monolithically integratable photodetector with 0.2 a/w responsivity for ultimate use at 1600 nm. The detector will rely on the intrinsic carrier lifetime of the semiconductor for its speed and on submicrometer-spaced interdigitated finger electrodes for its sensitivity. One semiconductor already developed for shorter wavelength applications is Low-Temperature-MBE-Grown GaAs (LT-GaAs). This material is rich in arsenic deep-level trapping centers, resulting in its subpicosecond carrier lifetime. Using LT-GaAs, we have recently developed a photodetector, sensitive out to 800 nm, that has a 1.2 picosecond response time and 0.1 a/w responsivity. This is the fastest photodetector in the world. We now wish to apply the technique of low-temperature MBE to in GaAs material for development of picosecond photodetectors sensitive out to 1600 nm. During this Phase I program, we will investigate the low-temperature growth of in GaAs on GaAs. We have found that by growing a lattice-mismatched layer, we can obtain high-resistivity material with no loss in sensitivity. We will study the epilayer system in terms its lifetime, mobility. dark current, and voltage hold-off, as functions of the growth-and post-annealing temperatures. We will then fabricate photodetectors and characterize using picosecond electro-optic sampling.

POWER TECH SOUTH
2912 AIR PARK ROAD
FUQUAY-VARINA, NC 27526
Phone: (919) 522-9054

Topic#: 93-005 ID#: 93-768
Office: BMDO
Contract #: F33615-93-C-2374
PI: John C. Driscoll

Title: Semiconductor-Insulator-Semiconductor (SIS) Power Device for High Temperature, Speed and Power Application

Abstract: This proposal is for the development of an optically activated high voltage semiconductor switch device capable of switching loads on and off within nanoseconds or picoseconds. A device of this type would not be possible using the existing limitations imposed by the limited knowledge on the transport of both electrons and holes across a Metal-Insulator-Semiconductor (MIS), and Semiconductor-Insulator-Semiconductor (SIS) interface. In order to provide this type of a device, a uniform bilateral flow of electrons and holes must take place through the interface. To properly characterize this phenomena so that an optically activated gapped semiconductor device of this type can be developed, a Scanning Tunneling Microscope (STM) will be used to establish the ballistic electron and hole transport mechanisms in insulator and semiconductor interfaces. This characterization data will make it possible to develop a new design for high power switching devices. The development of a high voltage power semiconductor device with rapid response time capable of being optically switched within nanoseconds or picoseconds can then be accomplished using simultaneous tunneling of both holes and electrons through the Semiconductor-Insulator-Semiconductor (SIS) interface. Two injecting semiconductor junctions (PN-, GAP, P-N) based in SI, GaAs or SI C materials with OHMIC contacts at both ends will be separated by a gap or oxide interface where tunneling of both electrons and holes can be enhanced (controlled?) by photon injection into the interface.

PROPULSION RESEARCH, INC.
4511 DALY DRIVE
CHANTILLY, VA 22021
Phone: (703) 968-0200

Topic#: 93-016 ID#: 93-003
Office: BMDO
Contract #: DNA001-93-C-0101
PI: Carl Anderson

Title: High Performance "Supercon" Electric Engine

Abstract: Engine electric high-speed magnetostrictive material long-life Propulsion Research Inc. will develop an ultra-efficient, high power low weight compact electric engine using a revolutionary physical concept. It will allow the creation of electric powered engines for uses in everything from "weed-wackers" to submarine engines. These engines have the potential for high starting and running torque, high rpm, high output horsepower per unit weight and size, small size, low weight, very low input power and ultra-long life because of minimal moving parts. Phase I will establish engine size, weight and performance parameters, and feasibility through a bench prototype.

QUANTEX CORP.
2 RESEARCH COURT
ROCKVILLE, MD 20850
Phone: (301) 258-2701

Topic#: 93-011 ID#: 93-236
Office: BMDO
Contract #: N60921-93-C-0097
PI: Xiangyang Yang

Title: Electrically and Optically Dually-Addressable Spatial Light

abstract: Spatial Light Modulators (SLMs) play a critically important role in optical signal processing and optical computing. The objective of this proposed work is to develop a novel electrically and optically dually-addressable slm using Quantex Electron Trapping (ET) materials. In addition to its fast response time, high resolution, large dynamic range and low driven voltage, the proposed ET-SLM has two input ports and can be addressed simultaneously by an optical input and an electrical input. This unique feature substantially improves the versatility and application flexibility of the ET-SLM. It also provides the system developer a more powerful device to develop innovative optical processing architectures that are not implementable with currently available SLMs, either optically or electrically addressable. In Phase I of this project, single-pixel sample devices will be fabricated and characterized to determine the feasibility of the proposed dually-addressable ET-SLM. A limited-scale prototype will also be designed. This prototype will bw fabricated, tested, and delivered in Phase II.

QUANTUM MATERIALS, INC.
9938 VIA PASAR
SAN DIEGO, CA 92126
Phone: (619) 695-1716

Topic#: 93-014 ID#: 93-081
Office: BMDO
Contract #: F19628-93-C-0121
PI: Steven Dershem, PHD

73

Title: Organic and Polymer Materials with Electronic Characteristics
Abstract: Novel Ethynyl functionalized monomers will be synthesized and characterized. These monomers will then be polymerized via cyclotrimerization catalyzed by transition metal catalysts to yield highly cross-linked aromatic products. The starting monomers would be low melting, low molecular weight compounds. The polymerized materials would have extended conjugation and are anticipated to be semiconducting as formed. Furthermore, treatment of the polymerized products with electron donating or electron withdrawing dopants is expected to further boost the thermal and electrical conductivities several orders of magnitude to that of metals. The polymeric materials proposed here would consist of all or nearly all aromatic ring structures. The thermal and oxidative stability of these products, therefore, is anticipated to be very high. The combination of semiconducting and/or conducting properties as well as outstanding processability and thermal stability is expected to make these materials very useful for high performance applications. SERS envisioned for these polymers include applications for EMF shielding, organic transistors, and light weight conductor runs for aerospace and deepspace applications.

QUANTUM TECHNOLOGY, INC.
108 COMMERCE STREET
LAKE MARY, FL 32746
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Topic#: 93-014
Office: BMDO
Contract #: N62269-93-C-0569
PI: Ratan Adhav, PHD

ID#: 93-719

Title: High Repetition Rate 100w Average Power BBO Q-switch For Nd:YAG
Abstract: In Phase I of this proposal we wish to investigate a new material B-BBO as high average power and high peak power electro-optic intracavity pockels cell. Such a device is required for diode-pumped Nd:YAG solid-state lasers for handling circulating powers up to 100 watts. Present materials are limited with serious thermal heating and subsequent damage due to linear optical absorption problems. Crystal B-BBO is an order of magnitude more resistant to thermal fracture than KD*P or LiNbO(3). We propose to characterize and test a B-BBO Q-switch for high average power applications at 1064 nm with a Nd:YAG laser. A B-BBO pockels cell will be fabricated with a 3x3x10 mm3 rod at Quantum Technology Inc. and used in our experiments. B-BBO Q-switches could very well replace KD*P and LiNbO(3) pockels cells for special applications involving high average powers (100w) and high peak powers (5gw/cm2).

SCHAEFFER INDUSTRIES
2421 WEST PRATT BLVD., M/S 445
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Topic#: 93-006
Office: BMDO
Contract #: NAS3-27016
PI: Richard Badke

ID#: 93-678

Title: Composite Insulators for 3000 Degree Celsius Environments
Abstract: An important component of ARCJET thrusters is the insulator holding the cathode base and separating the electrodes. The current baseline material is boron nitride (BN), which is well known for its high electrical resistivity and high thermal conductivity. However, at arcjet operating temperature, BN has a dramatic increase in electrical conductivity and a decrease in thermal conductivity. Additionally, the vapor pressure of BN becomes appreciable above 2000 degree C. A new composite insulating material will be investigated in the proposed program. This material will have a tailorable thermal conductivity, low vapor pressure and high electrical resistivity with an operating range up to 3100 degree C.

SCIENCE & ENGINEERING ASSOC., INC.
SEA PLAZA, 6100 UPTOWN BLVD. NE, SUITE 700
ALBUQUERQUE, NM 87110
Phone: (505) 884-2300

Topic#: 93-004
Office: BMDO
Contract #: F33615-93-C-2339
PI: James D. Cramer

ID#: 93-312

Title: Measurements of Fission-Fragment Ionization Phenomena
Abstract: An advanced reactor with a 50-75% efficient electrical energy conversion process incorporated within a core comprised of fuel and moderator provides options heretofore unrealized. In principle, the requirements for the feasibility of such a compact reactor could be met with the development of energy conversion materials that could operate efficiently in the hostile radiation environment of substained nuclear reaction. Candidate materials for such energy-conversion are, for example, boron-rich compounds that have been proposed as high temperature thermoelectric materials. Most of the energy loss of a fission-fragment in a solid is converted to ionization of the surrounding material. The ionization energy of neutron-induced fission-fragments could be used to generate electrical energy in such materials with efficiencies approaching 75% compared to the 5-10% presently

achieved with thermal excitation. The general requirements for this conversion process are that the fissile material must be embedded in or near the device within the range of the fragments. The innovation presented here is method to easily simulating the energy deposit of fission-fragments in candidate energy-conversion materials and to measure device performance in the laboratory. Ion beams capable of simulating the energy and mass of fission-fragments are available to Science and Engineering Associates, Inc. at both Sandia National Laboratories and Los Alamos National Laboratory.

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Topic#: 93-003 ID#: 93-397
Office: BMDO
Contract #: DASG60-93-C-0122
PI: Hyo Sang Lee

Title: Pseudo-random-modulated, CW Range-doppler Diode Laser Radar

Abstract: A new range-doppler laser-radar for solid target detection with 1 m range and 0.5 m/s velocity resolution at ranges up to several hundred kilometers is proposed. A multi-beam agile scanner feature will provide angular discrimination across a large FOV image with a wide field of regard. Range resolution, down to 1 m, and velocity resolution down to 0.5 m/s (with a dynamic range up to 11,000 km/s) are obtained using SESI's proprietary pseudo-random-modulation CW laser-radar technique, respectively. In this sensor concept, a CW infrared laser diode transmitter is modulated by a pseudo-random code, and the return is passed through a doppler filter. Digital processing is used to determine the range and velocity of the target in real time. The optical receiver will consist of a small size telescope, simple doppler optics and a pair of detector arrays. A system microprocessor will acquire data, process it, and present the result in both digital and visual format. The proposed compact, lightweight, cost effective laser-radar will be intrinsically insensitive to noise as well as other system biases, promising robust performance under field conditions. The low power consumption and design simplicity of the system will allow for autonomous, maintenance-free, airborne and spaceborne operations. In Phase I of this program we propose to carry out proof-of-concept experiments for subsystems, critical system analysis, and preliminary system design.

SCIENCE RESEARCH LABORATORY, INC.
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SOMERVILLE, MA 02143
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Topic#: 93-016 ID#: 93-023
Office: BMDO
Contract #: DNA001-93-C-0098
PI: Daniel Birx

Title: Electromagnetic Shock Line Sources

Abstract: Electromagnetic shock line IGBT subnanosecondpulses Science Research Laboratory will develop a new input charging technique by combining Insulated Gate Bipolar Transistors (IGBTs) and branched magnetic technology which will allow operation at pulse repetition rates in excess of 100,000 pps. In Phase I, the design verification testing will be done, establishing 100,000 pps operation of the commutator module at the front end of an electromagnetic shock line system. A compact lightweight, 100 MW peak power electromagnetic shock line system based on this ultra-high repetition rate will then be brought to final engineering design. This system will deliver subnanosecond pulses having risetimes of less than 200 picoseconds. Applications include high resolution radar, ECM and ECCM. Low power versions (10-100mw peak) include intrusion detection as well as ground penetrating radar for detecting utility lines.

SCIENTIFIC RESEARCH ASSOC., INC.
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Topic#: 93-010 ID#: 93-542
Office: BMDO
Contract #: DASG60-93-C-0051
PI: Harold L. Grubin

Title: Multiple Value Logic Element

Abstract: Virtually all present digital ICs are based on binary logic. The constraints in terms of increased density center around issues of complexity in design, loss through additional interconnects, power dissipation, etc. Concomitant to binary ICs has been the notion that the introduction of logic elements with multiple states could reduce the complexity of the design, reduce the number of interconnects, and improve the speed and output of the IC. Multiple Value Logic (MVL) elements constructed from Resonant Tunneling Diodes (RTD) have already been demonstrated. To established a technology based upon RTD-MVL structures robust device design must be implemented establishing the reliable speed advantages and density increases. U.S. Patent 5,128,894 by H.C. Lin establishes the procedures for robust device and circuit design, for three and 'n'-state logic. This

proposal using the combined design procedures of Scientific Research Associates (with DENMAT, a quantum transport code) and the fabrication and test facilities at the University of Maryland (the staff of H.C. Lin) will establish the feasibility of high speed MVL-RTD.

SECURE COMPUTING CORP.
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Phone: (612) 482-7437
Topic#: 93-010 ID#: 93-322
Office: BMDO
Contract #: DASG60-93-C-0053
PI: Thomas R. Markham
Title: Securing Multiprocessor Multilevel Computers
Abstract: When multiple processors are running potentially hostile code there is a very real threat of convert channels. This threat has prevented highly assured system from using multiple processors in an efficient manner. The proposal will examine the multiprocessor issue and develop countermeasures to the convert channels. Secure Computing Corporation has experience with convert channel detection techniques such as noninterference and the shared resource matrix methodology. Secure Computing Corp. is also very familiar with the lock system. This experience significantly increases the chances of secure computing finding solutions to the multiprocessor convert channel problem. The lock type enforcement mechanism provides an additional tool which may be used to maintain security without sacrificing performance. The result of this study will be a high level design which can be simulated to demonstrate the effectiveness of the countermeasures developed. Simulation of the design in Phase II will also allow tuning of the countermeasures to identify tradeoffs between security and performance.

SI DIAMOND TECHNOLOGY, INC.
2435 NORTH BLVD
HOUSTON, TX 77098
Phone: (713) 529-9040
Topic#: 93-003 ID#: 93-227
Office: BMDO
Contract #: F19628-93-C-0100
PI: Keith Jamison, PHD
Title: Large Area Single Crystal Cubic Boron Nitride Growth
Abstract: Wide bandgap materials such as cubic boron nitride hold significant promise for advanced applications such as UV lasers and detectors, as well as high temperature, high performance electronic devices. However study of these materials has been limited due to lack of large area high quality single crystals of these materials. In this Phase I project, we propose to enhance a proprietary process developed by the Diamond Laboratory at Wayne State University and licensed by SI Diamond Technology, Inc. to grow heteroepitaxial cubic boron nitride using reactive ion laser deposition. To date, this growth process has shown heteroepitaxial CBN thin film growth on silicon over an area of 1 cm^2. To further enhance this growth process, SI Diamond Technology will use its unique combination of diagnostic tools and laser growth facilities to analyze and, in collaboration with Wayne State University, improve their hetereopitaxial CBN on silicon growth process. Our analytical tools include direct recoil spectroscopy and mass spectroscopy of recoil ions, along with the various lasers available at our laser diamond growth facility. Some of these facilities are not available at Wayne State University, therefore, this project is will enhance their ongoing efforts by exploring methods to increase the CBN growth rate and reduce defect density of the CBN film. Phase I of this effort will be directed towards improve materials growth with the latter parts of Phase II being directed towards device development. This will include prototype devices such as a UV laser and CNB/diamond hemt structures. This collaborative effort between industry and university will find high quality CBN growth conditions more rapidly and provide a direct commercialization path so the CBN substrates will be available to the larger scientific community rapidly.

SI DIAMOND TECHNOLOGY, INC.
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Phone: (713) 529-9040
Topic#: 93-005 ID#: 93-713
Office: BMDO
Contract #: F33615-93-C-2338
PI: HOWARD K. SCHMIDT, PHD
Title: Diamond-metal Multilayer Packaging Technology
Abstract: We propose an innovative approach which leads to thick tungsten wires fully embedded in solid diamond slab. In this approach, thin films of Chemical Vapor Deposition (CVD) diamond are coated with a refractory metal and the metal is patterned. These patterned layers films are stacked and properly aligned, after which they are joined together by placing the stack in a diamond CVD chamber. The interlayer vias are made by either laser drilling or by reactive ion etching and the vias are filed by tungsten CVD. The top metal layer can be patterned to create the complete interconnect board. The objective of the

Phase I project is to examine the feasibility of this concept by building a two layer stack of diamond-metal interconnects. We will demonstrate a complete very high thermal performance diamond-metal multi-layer interconnect technology and do electrical and thermal performance tests in the Phase II of this project.

SI DIAMOND TECHNOLOGY, INC.
2435 NORTH BLVD
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Phone: (713) 529-9040
Topic#: 93-014 ID#: 93-228
Office: BMDO
Contract #: DNA001-93-C-0094
PI: Keith Jamison, PHD
Title: Large Area Single Crystal Diamond Growth

Abstract: Diamond exhibits physical properties that make it a[illegible]al material from which to construct electronic devices for high temperature, high frequency and/or high radiation applicati[illegible] To realize the substantial promise of diamond as an electronic material, substrates larger than those provided by natural d[illegible]mond must be available, with diamond hetereopitaxy the key to larger diamond substrates. In this Phase I project, we propose to examine and enhance a proprietary process developed by the Diamond Laboratory at Wayne State University and licensed by SI Diamond Technology, Inc. to grow heteroepitaxial diamond on silicon. SI Diamond Technology will use its unique combination of diagnostic tools and laser growth facilities to analyze the growth process. The diagnostic tools include direct recoil spectroscopy, mass spectroscopy of recoil ions, reflection high energy electron diffraction and low energy electron diffraction. Because some of our analysis tools and laser facilities are unavailable at the Wayne State University Diamond Laboratory, our efforts will enhance and compliment their ongoing diamond growth efforts are be directed towards determining the reason for the sparse diamond nucleation. This collaborative effort between industry and a university will find the diamond nucleation and growth conditions more rapidly and provide a direct commercialization path so the diamond substrates will rapidly be available to the larger scientific community.

SI DIAMOND TECHNOLOGY, INC.
2435 NORTH BLVD
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Phone: (713) 529-9040
Topic#: 93-014 ID#: 93-229
Office: BMDO
Contract #: DASG60-93-C-0100
PI: Keith Jamison, PHD
Title: Metal Doped Diamond as a Laser Material

Abstract: Doped single crystal diamond is a promising material upon which to base a new class of solid state lasers and optical devices operating at higher power densities and shorter wavelengths than conventional materials allow. At present, however, no acceptable method exists for producing metal doped diamond reproducible at controlled doping levels. Our current research suggests a novel method of incorporating any desired element at well defined concentrations into the diamond lattice during growth under Low Pressure Chemical Vapor Deposition (LPCVD) conditions. We shall demonstrate this approach by producing ND and TI doped crystals and evaluating their optical characteristics during Phase I. After establishing a reliable process technology and surveying metal doped diamond crystals early in Phase II, we will concentrate on producing useful laser and optical amplifier devices from doped diamond substrates.

SI DIAMOND TECHNOLOGY, INC.
2435 NORTH BLVD
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Phone: (713) 529-9040
Topic#: 93-014 ID#: 93-714
Office: BMDO
Contract #: N00014-93-C-0245
PI: Howard K. Schmidt, PHD
Title: Liquid Metal Cluster Ion Source For Repair Of Packaging

Abstract: We propose the development of a Direct Metal Etch and Write (DMEW) technology based on recently developed Liquid Metal Cluster Ion Sources (LMCIS) for repair of conducting paths in polyceramic system. The LMCIS's advantages over competing direct write technologies include high deposition rate, no pre- or post-processing, good adhesion and almost bulk metallization resistivity. This high throughput and localized deposition capability will enable TJIS technology to be useful in optical test and repair of multi-layer density interconnect substrates populated MCMS, bare die bumping, and personalization of semi-custom MCMS. The objective of this project during Phase I are to demonstrate the feasibility of this patented and proprietary direct write technology for repair of conducting paths in polyceramic system. During Phase II, we will develop a production worth DMEW tool and related process technologies for metallization repair.

SI DIAMOND TECHNOLOGY, INC.
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Phone: (713) 529-9040
Topic#: 93-014 ID#: 93-767
Office: BMDO
Contract #: N00014-93-C-0095
PI: Howard K. Schmidt
Title: High Power Diamond Cold Cathode

Abstract: We propose development of high performance cold cathodes based on our recently invented diamond field emission thin films. The diamond cold cathodes offer higher stability, larger emission site density, much higher lifetime than existing cold cathodes. Diamond's higher thermal conductivity, higher thermal diffusivity and lower sputter yield discourages thermal evaporation of emission sites, and thus reduces the possibility of anode-cathode (A-K) gap closure. In addition, diamond negative electron affinity allows extremely high currents (-1000a/sq. cm) can be emitted at low electric fields. The cathode is made of an Amorphic Diamond (TM) thin film deposited by laser ion plasma method, and consists of SP3 grains on the order of a few hundred to few thousand angstroms in size. Each one of these grains can act as an electron emission site, giving a very high (-10e8/cm^2) site density. The cathode lifetime is further increased because each site now needs to deliver very small amount of current. Additionally, relatively high lateral resistance of diamond film (in the plane parallel to the film) ensures adjacent emission site isolation, without dissipating large powers in the cathode. These cathodes have been tested to deliver a continuous current density of 10a/sq. cm without any noticeable damage to the cathode. In Phase I of this project, we will determine the electric fields, current density and usefulness of this technology in directed energy weapons.

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Phone: (602) 893-6245
Topic#: 93-013 ID#: 93-543
Office: BMDO
Contract #: DASG60-93-C-0096
PI: Ken Lou
Title: Manufacturing/in-service Health Monitoring of Composite Structures

Abstract: Advanced composite materials have evolved to be the class of materials which meet the strict requirements of many ground-and space-based critical structures. Systems which incorporate these novel materials are frequently exposed to harsh environments during service, and must therefore be manufactured using high quality standards. Not only it is desirable to monitor and control the fabrication process using embedded sensors, but it is also necessary to instrument these structures with devices which allow in-service health monitoring. Optical fiber sensors have been investigated for these purposes over a number of years, but have yet to be reduced to practice in an integrated, multi-parameter, spatially-multiplexed format. It is proposed to demonstrate the feasibility of an optical time domain fiber strain-and temperature-monitoring network that can be integrated with a novel fiber optic-process monitoring system for composite materials. The proof-of-concept test consists of fabricating a thermoset composite laminate which contains a multi-segment optical fiber sensor network, monitoring the state of cure during the fabrication of the laminate, and determining strain and temperature during tests performed after fabrication. Software will be written to interface a commercially available optical time domain monitoring system to a personal computer.

SPACE COMPUTER CORP.
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SANTA MONICA, CA 90404
Phone: (310) 829-7733
Topic#: 93-003 ID#: 93-451
Office: BMDO
Contract #: N00014-93-C-0173
PI: William Kendall, PHD
Title: Non-uniformity Infrared Sensors

Abstract: Two related problems which limit the performance of staring infrared sensors are detector non-uniformity and inadequate resolution. Removal of detector and readout non-uniformities ("fixed-pattern noise") is essential for the detection of low-observable targets in cluttered backgrounds. Adequate resolution is essential for separating closely-spaced objects and making accurate measurements of their locations. The conventional approach to non-uniformity correction is calibration of each detector by introducing two or more reference sources into the sensor field of view. This approach is effective, however, only when the detector-to-detector non-uniformities remain constant over times longer than that between calibrations. This is often not the case due to temperature changes, system instabilities, 1/f noise, etc. The only straightforward method to increase resolution is to increase the size of the optical aperture and decrease the detector spacing. This is expensive solution in terms of weight, complexity and cost. We have developed an elegant new solution to these problems based entirely on processing of the sensor output signals. We use multiple image frames, and take advantage of the sensor aimpoint wander caused by jitter, residual tracking errors, or deliberately induced motion. Such wander causes each detector in the array to view multiple scene

and low insertion loss.

SYNECTICS CORP.
111 E CHESTNUT ST
ROME, NY 13440
Phone: (315) 337-3510
Topic#: 90-091 ID#: 41140
Office: NAVAIR
Contract #: N00019-92-C-0198
PI: Arnold H Lanckton
Title: Digital Image Verification System (DIVS)
Abstract: Develop a digital image verification system. For further information contact Ms. Nodgaard at (703) 692-7390 x6309.

SYNETICS CORP.
540 EDGEWATER DRIVE
WAKEFIELD, MA 01880
Phone: (703) 848-2550
Topic#: 91-035 ID#: 91N47-214
Office: SPAWAR
Contract #: N00039-93-C-0061
PI: Richard Fastring
Title: Local Area Network (LAN) Security
Abstract: A unique, state-of-the-art, multi-node, multi-user Wide Area Network (WAN) is proposed herein for test and evaluation which will enable sensitive or classified data to be transmitted between selected U.S. Navy laboratory locations. Open architecture packet communication techniques, and commercial off-the-shelf (COTS) hardware and software will be employed which will allow encrypted data to be transmitted between users via a general purpose public network rather than dedicated secure point-to-point links. The advantages of electronic key distribution, and other security features, will be evaluated as part of this Phase II effort. Completion of Phase II will provide sufficient information for making a decision to deploy the system for operational use.

SYNETICS CORP.
540 EDGEWATER DRIVE
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Phone: (703) 848-2550
Topic#: 91-300 ID#: 91N40-345
Office: NSWCDDWO
Contract #: N60921-93-C-0063
PI: William J. Both
Title: Reverse Engineering of Assembly Code
Abstract: SYNETICS proposes to build on its Phase I research and analysis of ULTRA assembly code reverse engineering by designing, developing and implementing an Assembly Design Extractor (ADE) Program. This is to be fully tested and refined program which will extract ULTRA-16 and ULTRA-32 design information within a Naval Surface Warfare Center Dahlgren Division (NSSCDD) Software Reverse Engineering System (SRES). ADE will be designated to extract ULTRA design information from an NSWCDD On-Line Tools (OLTOOLS) tree and deposit the data into an Extended Elementary Statement Language (EESL) tree structure. This will automate not only software documentation but also the process of converting ULTRA to Ada. SYNETICS will then assist the NSWCDD in integrating the ADE program with a CMS-2 extractor and other components of the SRES. The final goal is an interactive ULTRA and CMS-2 software reverse engineering capability along with automated conversion of those assembly codes to Ada. SYNETICS will employ the Shipboard Gridlock System with Automatic Correlation and the AEGIS Tactical Executive System tactical computer programs as a test bed for the ADE development and as the SRES integration testing. SYNETICS will apply its direct recent experience in SGS/AC development to this test and analysis process. This will make it possible for the Navy to make rapid strides toward a comprehensive software reverse engineering capability and an automated Ada conversion methodology.

SYSTEM PLANNING CORP.
1500 WILSON BLVD.
ARLINGTON, VA 22209
Phone: (703) 276-6953
Topic#: 90-145 ID#: N90-145-1
Office: NAVSEA
Contract #: N00024-94-C-4065
PI: Lynwood A Cosby
Title: Ultra-wide Band Modular Solid-State Transmitter Array for Naval Electronic Warfare
Abstract: The objective of the program is to demonstrate innovative approaches to the provision of compact, flush-mounted, ultra-wideband (UWB), active phased arrays suitable for modern naval platforms requiring maximum integration of tactical systems operating in the UHF/VHF and microwave bands. The basic concept calls for a single UWB phased array that can

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transmitter operating in the near-infrared spectrum at a wavelength of 980 nm. The device is fabricated from a strained-layer, single-quantum-well InGaAs/AlGaAs epitaxial wafer. The laser design consists of a single-mode discrete master oscillator coupled to a flared-contact power amplifier. The master oscillator is a 150 mw diffraction-limited laser that can be modulated up to 1 GHz. The flared amplifier cleanly amplifies the master oscillator output up to the 5 watt power level. The output beam, after exiting the amplifier collimation optics, consists of a single gaussian diffraction-limited lobe. The laser source offers high reliability at a very high electrical-to-optical conversion efficiency exceeding 25%. The laser head is compact, rugged, and passively-cooled, therefore offering many advantages over competing high-power infrared lasers such as Ti:sapphire or diode-pumped Nd:YAG.

SPECTRA DIODE LABORATORIES, INC.
80 ROSE ORCHARD WAY
SAN JOSE, CA 95134
Phone: (408) 943-9411
Topic#: 93-014 ID#: 93-697
Office: BMDO
Contract #: N00014-93-C-0130
PI: Derek Nam
Title: Epitaxial Growth Of High Bandgap III-V Semiconductor
Abstract: Spectra Diode Laboratories (SDL) proposess to investigate high bandgap GaN related alloys for visible laser diodes and high temperature electronic devices. The proposed development of the high bandgap material will result in laser diodes spanning all range of the visible spectrum and high temperature electronic devices that can operate at greater 200 degree C. The goal of Phase I is epitaxial growth and characterization selected alloys. In Phase II, SDL will further refine and develop the processes demonstrated in Phase I to achieve CW visible laser diodes. The advancement of the GaN based semiconductors will result in blue laser sources and high temperature electronic devices that will greatly impact both commercial and military applications including high performance optical storage, color printing, color reprographics. Visual displays, high temperature aircraft engine sensors.

SPECTRAL SCIENCES, INC.
99 SOUTH BEDFORD STREET, #7
BURLINGTON, MA 01803
Phone: (617) 273-4770
Topic#: 93-013 ID#: 93-077
Office: BMDO
Contract #: N60921-93-C-0089
PI: Mitchell R. Zakin
Title: Fullerenes and Metallofullerenes Via Ultrasound
Abstract: The Fullerenes are a new form of carbon that possess many unusual properties. The most abundant Fullerenes, C60 and C70, show promise for many technological applications. Fullerenes encapsulating metal atoms (metallofullerenes) have potential as advanced catalysts and nanostructural materials. Presently, the barrier to widespread implementation of the fullernes and metallofullerenes is the inefficiency of currently available synthetic methods, which has resulted in a short supply and high price for pure C60 and C70. Other fullerenes and the metallofullerenes are not yet commercially available. Thus, there is a critical need for an efficient, inexpensive, high-yield process for fullerene synthesis. Spectral Sciences, Inc. (SSI) proposes to develop an ultrasound-based process for fullerene and metallofullerene synthesis which has potential to meet these criteria. This process utilizes relatively simple and inexpensive equipment, and can be performed on a laboratory benchtop. Phase I will consist of a proof-of-concept demonstration of the feasibility of large-scale fullerene and metallofullerene synthesis using the ultrasonic technique, and will include a design study for a scaled-up version of the fullerene generator which will be constructed, tested, and optimized in Phase II. Certain precipitation hardenable MMC matrix alloys display more rapid coarsening at fibermatrix interfaces than within the matrix. Upon axial loading, the precipitates serve as stress intensifiers in the plane of the interface. The interface is weakened by reducing the Work of Decohesion (WD). This enables the delamination toughening mechanism and composite strengths are greatly increased. Since the decrease in WD is related to the size and distribution of precipitates on the interface, WD can be specified and controlled through simple heat treatment, if we understand the kinetics of the interface coarsening process. We have demonstrated this effect and established kinetics in the AL-CU system and have termed this phenomena the Discontinuously Coated Interface Effect (DCITM). Transverse and axial strengths can be substantially improved through heat treatment alone. The need for expensive fiber surface coatings are unnecessary. The principle objective of this program is to demonstrate this effect in interesting high temperature Al matrix alloys and more complex ternary alloys that are age hardenable reinforced with alumina (nextel 61).

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SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000

Topic#: 93-003 ID#: 93-398
Office: BMDO
Contract #: DASG60-93-C-0072
PI: Edward A. Johnson

Title: Ion Polishing of Polycrystalline Diamond Interceptor Windows

Abstract: Chemical Vapor Deposition (CVD) and related processes have been developed for applying synthetic diamond films for this application. However, in spite of recent progress, CVD diamond is still unsatisfactory, because the deposits are polycrystalline in form with grains of varying sizes and orientations, causing optical scatter. Polishing of diamond films with diamond particles can be used to reduce this scatter, but the polishing is long and expensive, and does not produce ideal results. Furthermore, during mechanical polishing, grains in the film frequently become dislodged, extending the necessary polishing time. Spire proposes an ion beam process to improve the quality of polishing of polycrystalline diamond. The Phase I program will use an Electron Cyclotron Resonance (ECR) plasma to generate the ion beam for polishing polycrystalline diamond films and will compare results with those from ion polishing with a Kaufman source. Process parameters, such as beam energy, current density, ion species, background atmosphere, and substrate preparation and temperature will be varied to find promising conditions for Phase II optimization.

SPIRE CORP.
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Topic#: 93-004 ID#: 93-549
Office: BMDO
Contract #: DASG60-93-C-0069
PI: CHARLES C. BLATCHLEY PHD

Title: Textured Metal Radiator for Direct Thermophotovoltaic Energy

Abstract: In thermophotovoltaics, an incandescent radiator illuminates a photovoltaic cell which converts radiant heat to electrical energy. Thermophotovoltaic systems are attractive for space power since, in principle, they can achieve conversion efficiencies considerably higher than the 6% to 8% characteristic of current thermoelectric generators. The crucial problem for this technology is matching the emission spectrum of the radiator to the bandgap of the photocell. Current approaches to overcoming this problem include fabricating radiators with strong emission lines and placing filters between the radiator and photocell. We propose an alternative radiator using ion beam textured metal surface. In earlier work, we tailored metal surfaces to have very emissivity at short wavelengths and much lower emissivity at longer wavelengths. Ion beam texturing offers precise control over the size and shape of micronscale surface texture features and these, in turn, determine the emissivity spectrum of the metal surface. In Phase I, we will texture the surface of titanium metal to produce an emissivity cut-off wavelength around 2 um. Using photocells already available at Spire, we will construct a proof-of-concept thermophotovoltaic converter system and use this system to determine the efficiency which can be achieved with textured metal radiators.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
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Topic#: 93-005 ID#: 93-442
Office: BMDO
Contract #: NAS3-27004
PI: Steven Wojtczuk, PHD

Title: High End-of-life Power Density InP-on-Ge Solar Cells

Abstract: InP solar cells possess unique intrinsic radiation hardness and selfrecovery mechanisms which make them an enabling technology, allowing missions in high-radiation orbits in the Van Allen belts previously avoided with CaAs and Si cell technologies. One-sun InP cells exceeding 19% efficiency at AMO (a world record) have been built at spire; even greater efficiency could be obtained with InP concentrator cells. However, InP cell use has been limited by the cost and fragility of the inp substrates, which requires using thicker and heavier substrates, adding to the launch weight. Spire proposes to overcome these limitations by exploring the performance of InP cells on Ge wafers, a cell type never before investigated. Ge wafers are less than 1/10th the cost of InP in large quantities. They are much stronger than InP wafers, so much thinner and lighter substrates can be used. In high radiation orbits equivalent to fluences of 10 (17) 1 meV electrons/cm2, we predict a 15% Beginning-Of-Life (BOL) InP-On-Ge cell will have up to 20% higher End-Of-Life (EOL) power density than a 19% BOL InP-On-Inp cell, due to its lighter, lower cost Ge wafer, and may have up to 250% higher EOL than a 14% BOL SI cell, due to the higher InP EOL efficiency.

SPIRE CORP.
ONE PATRIOTS PARK
BEDFORD, MA 01730
Phone: (617) 275-6000
Topic#: 93-014 ID#: 93-559
Office: BMDO
Contract #: N00013-93-C-0176
PI: Fereydoon Namavar, SCD
Title: Si-based Blue Light Emitting Diode
Abstract: Under an ongoing SDIO-funded SBIR Program, Spire recently demonstrated the first Si-based visible Light-Emitting Diodes (LED), obtaining colors ranging from red through yellow. These Si devices were produced as nanodimensional structures from P-type substrates by electrochemical etching. The shorter wavelengths resulted from reducing the structure size to the 1-2 nm level. However, calculations of the confinement energies of electrons and holes in Si nanostructures indicate that the crystal dimensions required for blue emission are generally too small to be stable over extended periods. We propose that the constraints on microcrystalline dimensions for producing blue leds can be relaxed by creating alloys of Si which intrinsically possess larger energy gaps. Significantly, since crystalline carbon (diamond) has a large bandgap (5.5 eV), alloys of several percent C in Si will readily increase the base bandgap; however, mismatches in unit cell dimensions will be detrimental, unless germanium atoms are also introduced to compensate. We predict that the optical emission properties will be affected predominately by C, allowing formation of a new material exhibiting quantum confinement effects plus dimensional stability. In Phase I, we shall use spire's proven non-equilibrium deposition conditions, already applied to SI(1-x)Ge(x), to assure the formation of Si(1-x-y)Ge(x)C(y) alloys, 0,x,y < 5%, without suffering the formation of undesirable second phases, and demonstrate blue photolum-inescence in etched structures. We will demonstrate blue electrolum-inescence in porous SiGeC-based devices in Phase II.

STRATEDGE CORP.
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SAN DIEGO, CA 92123
Phone: (619) 569-5000
Topic#: 93-012 ID#: 93-706
Office: BMDO
Contract #: DASG60-93-C-0111
PI: Napolean Fulinara
Title: Miniature, Robust Stripline Bandpass Filters for Mobile
Abstract: The objective of this program is to build a microwave bandpass filter with ceramic multilayer packaging technology in order to create a light weight, low volume, temperature stable filter. Stratedge packaging technology can advance the state-of-the-art in miniature passive microwave component using high dielectric constant, low loss (high-q) ceramic substrates. A filter is selected as the circuit od choice because it is used in avast array of electronic systems. Incorporation of these multilayer ceramic circuits in T/R modules or multichip modules presents a practical option to the circuit designer. The devices can be incorporated in a modular fashion in highly integrated designs. The potential of combining the stripline substrates into the package itself would be addressed under a Phase II effort.

STRUCTURED MATERIALS INDUSTRIES, INC.
240 MARTIN LUTHER KING BLVD
NEWARK, NJ 07102
Phone: (201) 471-3589
Topic#: 93-005 ID#: 93-615
Office: BMDO
Contract #: DASG60-93-C-0115
PI: Gang Sun, PHD
Title: Porous Polycrystalline Silicon Solar Cells
Abstract: It has been shown that efficient photoluminescence can be observed from porous silicon, when the porosity is sufficiently high. This result has been attributed to quantum size effects, due to the formation of silicon "wires". In recent work aimed at the development of light emitting devices, we have also demonstrated photoluminescence ranging from IR, through the visible, to UV, in Si and Ge Quantum Nanocrystals (QNCs) embedded in a silicon dioxide (SiO(2)) matrix. We now propose to develop porous silicon solar cells based on the recent results and our knowledge of nanostructured materials. These solar cells will be fabricated by a unique wafer bonding process and also by modifying existing commercial solar cells. The band structure of porous silicon is ideally suited for solar cell applications. This is supported by the recent demonstration of a highly sensitive photodetector, with close to unity quantum efficiency.

SUMMIT DEVICE TECHNOLOGY
2373 DISTINCTIVE DRIVE
COLORADO SPRINGS, CO 80920
Phone: (719) 260-6831
Topic#: 93-014 ID#: 93-069
Office: BMDO
Contract #: DASG60-93-C-0110
PI: John Platenak

Title: Non-volatile Semiconductor Memories
Abstract: Non-volatile semiconductor memories for radiation environments can benefit from advanced electronic materials. We propose to investigate some novel materials for application to non-volatile semiconductor memories which could improve performance in radiation environments. In Phase I, we will attempt to develop two methods of depositing thin films of these novel materials, characterize the deposited films, optimize the deposition methods, fabricate capacitors from the thin films, and do preliminary characterization of the capacitors. Detailed characterization of capacitors of these materials would be performed in Phase II.

SUPERCONIX, INC.
261 FIFTH STREET EAST
SAINT PAUL, MN 55101
Phone: (612) 222-0046
Topic#: 93-003 ID#: 93-388
Office: BMDO
Contract #: DASG60-93-C-0075
PI: Charles Gallo
Title: Cryocoolers Based On Adiabatic Magnetization Cooling Of High
Abstract: We propose to investigate the feasibility of a family of novel magnetic cryocoolers. In the proposed technology, magnetic working media made of appropriate high temperature superconductors are used. When the superconductor is quenched or partially quenched in a magnetic field, decoupling of the charge-carrier-pairs causes a temperature drop in the superconductor. In other words, an "inverse magnetocaloric effect" occurs. We expect such cryocoolers to have higher temperature-lifts than traditional magnetic heat pumps using para/ferromagnetic materials. An additional advantage is that the magnetic field is applied at the low temperature portion of the thermodynamic cycle, thus reducing problems associated with the need to keep superconducting magnets at very low temperatures. In some designs, movement and pumping of cryogenic fluids is not required, thus circumventing sealing and tribological problems often encountered in traditional compression cycle cryocoolers. The main objectives of the phase I effort will be proving the general concept and determining some of the critical parameters. In Phase II, an actual experimental "superconducting" cryocooler will be built.

SUPERIOR VACUUM TECHNOLOGY, INC.
7620 EXECUTIVE DRIVE
EDEN PRAIRIE, MN 55344
Phone: (612) 934-1993
Topic#: 93-003 ID#: 93-696
Office: BMDO
Contract #: F33615-93-C-1277
PI: Peter Chow
Title: VLWIR Detector Using Strained Type II Superlatice
Abstract. The recently invented Type II strained layer superlattices made of GaInSb/InAs have shown great promise as IR detectors. Made of periods of materials each only a few atoms thick. It has several desirable optical and transport properties which would become even more important for VLWIR (>12um) applications. To explore the potential of this material system, we propose to investigate its use for detector device applications and demonstrate the predicted properties. Samples will be fabricated in a state-of-the-art MBE system using automated process control. We plan to study their dopant behavior and detector characteristics in a diode structure.

SUPERIOR VACUUM TECHNOLOGY, INC.
7620 EXECUTIVE DRIVE
EDEN PRAIRIE, MN 55344
Phone: (612) 934-1993
Topic#: 93-014 ID#: 93-689
Office: BMDO
Contract #: N00014-93-C-0131
PI: JAMES VAN HOVE
Title: (AlGaN)x(SiC)l-x Semiconductors for High Temperature Electronics
Abstract: A significant need exists for electronic devices operating above 200 degree C. These devices could be used in sensing and control applications in turbine, high power and high frequency microwave radar systems, automotive electronics and satellite communication systems. We propose to meet this need with the (III-N)x(SiC)x alloy system. Al(x)Ga(1-x) is a direct, wide bandgap semiconductor (3.4 to 6.2eV.) SiC's gap is also large (3.3eV). The melting point of GaN is 2000K and that of AlN and SiC is over 3200K. Novel properties are predicted for the alloy system that differ from each material. We propose to demonstrate the growth of AlGaN on SiC with jet-assisted epitaxy to create energetic nitrogen. The tasks will include fabrication of the supersonic N(2) jet source and installation in an existing MBE system. Material studies on the growth and nucleation of AlGaN will be done in-situ with Rheed, Cathodoluminescene, and IR pryometric interferometery. E-beam sources for both Si and C be will used to dope the Algan and to grow the SiC. Calculations of the band structure will be done.

TACAN CORP.
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CARLSBAD, CA 92008
Phone: (619) 438-1010
Topic#: 93-003 ID#: 93-157
Office: BMDO
Contract #: DASG60-93-C-0112
PI: James Bechtel
Title: High-Power Diode Laser Array Transmitter for Laser Satellite
Abstract: Tacan Corporation is developing a new approach to high-power diode laser array transmitters that is ideally suited for laser satellite communications. The transmitter uses an array of our patented wavelengths stabilization circuits to lock all of the lasers in the transmitting array to the same wavelength. This provides a dramatic improvement over current approaches that require bulky, heavy, and expensive and power hungry temperature compensation systems that are unsuitable for satellite applications. Our approach allows the use of currently available diode lasers to which we add a patented, passive stabilization grating. The grating determines the laser's transmission and wavelength which eliminates the necessity for costing and wasteful selection of lasers for the desired wavelength.

TECHNOLOGY DEVELOPMENT CORP.
4825 COMMERCIAL DRIVE
HUNTSVILLE, AL 35816
Phone: (205) 837-7762
Topic#: 93-003 ID#: 93-708
Office: BMDO
Contract #: N62269-93-C-0501
PI: Stephen M. Kosovac
Title: Compact CO2 MOPA-Configured Multiple-Folded Laser
Abstract: Technology Development Corp. has demonstrated that a 1-meter-long gain media CO(2) laser which is folded into a cylindrical volume that is 15 cm in diameter x 5 cm height can produce stable CW, mode-locked, and q-switched waveforms useful for laser, Multiple-Foiled Laser (MFL) radar has a 7.5 Kg mass. There are 4 objectives to this Phase I SBIR effort including: 1) demonstrate proof-of-principle that a pair of 3-meter multi-fold lasers can operate in a Master Oscillator Power Amplifier (MOPA) configuration and produce useful pulsed measurement waveforms with average, optical output power of at at least 100 watts; 2) conceptually describe 1 innovative, cost-reducing TMD application of a MOPA MFL for SDIO; 3) identify other candidate SDIO applications of MOPA MFL for sensors, seekers, and survivability; 4) plan a Phase II effort that will produce and demonstrate a compact MOPA MFL.

TETRA CORP.
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Phone: (505) 345-8623
Topic#: 93-002 ID#: 93-091
Office: BMDO
Contract #: DASG60-93-C-0046
PI: Juan M. Elizondo, PHD
Title: High Current Cathodes with Controlled A-K Gap Glosure
Abstract: The proposed program uses polarization reversal on ferroelectric materials that yield current densities in the K a/cm^2 range. The fast change in the polarization vector within the material results in a transition that liberates the polarization induced charges (4 p) resulting in a current pulse limited only by the transition time and space charge effects. The proposed program will develop the technology for microsecond long pulses. The use of ferroelectric material as the A-K structure should control plasma formations that result in gap closure.

TETRA CORP.
3701 HAWKINS STREET, NE
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Phone: (505) 345-8623
Topic#: 93-005 ID#: 93-084
Office: BMDO
Contract #: DNA001-93-C-0099
PI: Chris M. Young
Title: Advanced High Energy Density Capacitor Technology
Abstract: Capacitor technology is a major driver for the size and cost of many space power conditioning systems. Current technology for high voltage (>100v), high frequency (high rep rate) capacitors is limited to an energy density less than 7500 J/m3. We are proposing a revolutionary capacitor technology which promises to increase capacitor energy densities by factor of more than 100. In many applications, this will greatly reduce the size, weight, and cost of the power conditioning equipment. The proposed technology can operate at temperatures greater than 2000 C degree, operate in high tolerant. The proposed Phase I effort will demonstrate the feasibility of the technology with a small scale experimental demonstration. We will also develop a first order theoretical model of the device.

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TG&C ASSOC., INC.
ONE CESSNA LANE
FALMOUTH, VA 22405
Phone: (703) 371-3531
Topic#: 93-002 ID#: 93-750
Office: BMDO
Contract #: DASG60-93-C-0088
PI: T. G. Horwath
Title: Millimeter Wave Projectile Guidance
Abstract: A novel millimeter wave terminal guidance is proposed, which is uniquely suitable for small spinning projectiles. This guidance concept does not require inertial components. It utilizes the inherent inertial properties of projectile spin nutation. The concept can be implemented with very low weight and volume, and promises projectile cost savings of an order of magnitude. Applications of this novel terminal guidance concept include space based strategic defense, ground based strategic defense, theater missile defense, anti-ship missile defense, air defense, as well as numerous other tactical applications. Monolithic, all solid state, realizations appear feasible, which make this terminal guidance concept suitable for high acceleration environments, such as gun launch. Analysis, simulation, and experimental evaluation of the critical components are proposed for Phase I, together with planning the effort to be conducted during Phase II. The expected results of Phase I are the establishment of the technical feasibility, with a through quantitative understanding of how well this concept will perform in passive, semi-active, and active implementations. Numerous applications of the concept exist in non-defense, and commercial areas.

THERMACORE, INC.
780 EDEN ROAD
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Phone: (717) 569-6551
Topic#: 93-005 ID#: 93-266
Office: BMDO
Contract #: F33615-93-C-2326
PI: Nelson J. Gernert
Title: Nacent Hydrogen: An Energy Source
Abstract: This proposal concerns the development of a novel energy source for SDI applications. Hydrogen is used as a fuel; power producing electrolytic cell technology is used for the catalytic process; electrolysis is not required. The result is a passive, self sustaining non-electrolytic method for extracting energy from hydrogen. Hydrogen is supplied to a catalyst and energy ID predicted using this process than would be achieved by combusting the hydrogen with oxygen. The proposed Phase I objective will demonstrate the following: 500 watts at 300°C. This requires extension of the present state-of-the-art from 50 watts at 300°C. A future Phase II program would involve extending the power level to 10,000 watts in a package suitable for commercialization.

THERMACORE, INC.
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Phone: (717) 569-6551
Topic#: 93-005 ID#: 93-694
Office: BMDO
Contract #: F33615-93-C-2325
PI: John H. Rosenfeld
Title: Porous Metal Cooling Of Laser Diode
Abstract: Thermacore has recently demonstrated heat fluxes in excess of 6000 w/cm2 and heat transfer coefficients of nearly 100 w/cm2 - degree C using an approach called porous metal heat transfer,using copper as the heat exchanger material, and water as the coolant. The proposed program will meet all Semiconductor Laser Array Cooler (SLAC) requirements by adapting porous metal heat transfer using appropriate materials, coolant, and packaging. This will elimination cooling issues as limiting factor in laser diode operation. Phase I work will include definition of all relevant requirements for SLAC devices. The proposed program will utilize porous metal heat transfer to achieve cooling rates of over 1000 w/cm2 and eliminate cooling issues as limiting factor in SLAC power output. Phase I will demonstrate a heat exchanger that meets SLAC cooling requirements.

THERMACORE, INC.
780 EDEN ROAD
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Phone: (717) 569-6551
Topic#: 93-007 ID#: 93-261
Office: BMDO
Contract #: F29601-93-C-0146
PI: Scott D. Garner
Title: Unfurlable Capillary Pumped Loop Space Radiator
Abstract: The success of future space missions is dependent on the development of advanced radiators. This proposal describes a novel, lightweight, interior Capillary Pumped Loop (CPL) design that can be used for ambient temperature heat rejection. The heat pipe radiating system is extremely lightweight due to its interior CPL design which requires wick structure only in the

evaporator, and its innovative materials of fabrication. The proposed radiator will be fabricated from a polymer/metal laminate film. The use of this material results in an extremely light weight radiator (0.5 Kg/m2). This is a factor of fourteen (14) lower in mass than conventional space radiators weighing 7 Kg/m2. The radiator panel will be fabricated from a heat sealable, polymer/metal laminate that is divided into several indepent heat pipe cells. These multiple cells add redundancy to the system which yields increased reliability. The proposed interior CPL design allows microgravity operation without requiring a wick in the adiabatic or condenser sections of the heat pipe. The design is also self-priming and tolerant of non-condensible gas generation. The technical feasibility of the proposed innovation will be demonstrated through the design, fabrication and test of a proof-of-concept polymer/metal laminate heat pipe radiator.

TOP-VU TECHNOLOGY, INC.
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NEW BRIGHTON, MN 55112
Phone: (612) 633-5925

Topic#: 93-014 ID#: 93-187
Office: BMDO
Contract #: F33615-93-C-1276
PI: Chi Nguyen

Title: GaAs VLSI Readout Electronics for Infrared Focal Plane Arrays

Abstract: Gallium Arsenide (GaAs) technology advances have shown the capability for producing Very Large Scale Integrated (VLSI) circuits for digital computing applications. The intent of this project is extend the GaAs VLSI technology to analog readout electronics for the SDI Infrared Focal Plane Arrays (IRFPA's). The SDI infrared surveillance sensors and missile seekers require significant on-FPA electronics to acquire and track targets. In addition, these devices must survive and operate in the harsh, extreme temperature and acceleration environment for SDI applications. The advantages of GaAs VLSI readout electronics are low noise (Thermal, KTC and L/F), low dark current at cryogenic temperatures, high coupling efficiency with GaAs electronics, excellent radiation hardness, extremely wide operating temperature range (both high and low), high speed response, photonic integration and interface, low parasitic losses, and improved performance to fabrication cost ratio. Our approach is innovative, effective, and provides system capabilities unobtainable without the use of GaAs technology. The specific objective of the Phase I project is to develop a large array of GaAs readout multiplexer. The technical objectives of the Phase-I 6 months project are: 1) specifications development, 2) foundry selection, 3) multiplexer architecture, and 4) readout circuits. Performance parameters in terms of noise, bandwidth, dynamic range, power dissipation, etc. will be addressed.

TPL, INC.
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Phone: (505) 345-5668

Topic#: 93-003 ID#: 93-205
Office: BMDO
Contract #: DNA001-93-C-0096
PI: Timothy Tiernan

Title: Radiation Hard Detector Array for Visible Light, Gamma Rays and

Abstract: New technologies are required for the detection and imaging of visible light, gamma rays and neutrons in high radiation environments such as those encountered in space. Currently available, crystalline silicon detector arrays such as Charge Coupled Devices (CCD) are extremely susceptible to radiation damage and a few kilorads of high energy protons can seriously degrade performance in a matter of weeks or months. Newly developed, hydrogenated Amorphous Silicon (A-Si:H) pixel arrays hold great promise for imaging applications in high radiation environments. Recent research has shown that MOSFET's made with A-Si can withstand 5 Mrad of gamma rays and are at least 25 times less sensitive to gamma rays than similar crystalline silicon devices. Other research has shown that prototype A-Si:H pixel arrays can withstand 10°C rads of high energy photons with only a 1.3% drop in signal output. This damage can be completely reversed with modest heating to 130°C. These arrays can be suitable scintillator, used for imaging either gamma rays or fast neutrons. A Phase I program is proposed that will quantify the imaging capabilities of a prototype A-Si:H pixel array for visible light, gamma rays and fast neutrons. The radiation hardness of the pixel components with request to high energy protons and electrons will also be evaluated. Sensors associated with early-warning systems must detect ballistic missiles, which appear as moving point targets. Tracking techniques based on conventional signal or image processing algorithms require significant computational resources, provided by digital processors that are remote from the focal plane. We propose here a novel method for motion detection that can be implemented on-board the focal plane. This method, called the wave process, is a velocity bandpass filter for two-dimensional staring mosaic focal planes detecting moving point targets. It is resilient to background variations, platform jitter, and slight changes in target speed and direction. It is a distributed architecture, allowing it to identify many simultaneous regions of motion without suffering a slowdown. It is efficiently implemented in subthreshold VLSI which allows on-focal-plane application reducing system size, weight and power. Using preliminary exploratory research results on the wave process, this Phase I project will determine the

feasibility of the approach for missile defense systems.

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3754 HAWKINS NE
ALBUQUERQUE, NM 87109
Phone: (505) 345-5668
Topic#: 93-005 ID#: 93-271
Office: BMDO
Contract #: DNA001-93-C-0100
PI: Richard W. Brotzman
Title: Ultra-high Dielectric Constant Dielectric Materials
Abstract: Non-nuclear approaches are sought for high energy densities for space power systems. One critical component to achieve improved performance is capacitor stores. These are dependent upon advances in low loss, high energy/high power density storage materials. A unique inorganic composite is proposed for investigation as a high energy density storage material. An approach is formulated based on sol-gel chemistry and polymer physics which will allow materials with dielectric constants as large as 100 to be developed. Predicted breakdown strengths are greater than 3mv/cm. This represents a significant materials breakthrough. Phase I activities included: synthesis of the inorganic/organic composite and investigations to optimize the material; fabrication of films; and characterization of the dielectric films to include both mechanical and electrical testing. Designs for advanced capacitors will be developed and Phase II recommendations formulated. TPL has extensive experience in sol-gel chemistry and dielectric material synthesis.

UES, INC.
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Phone: (513) 253-3986
Topic#: 93-004 ID#: 93-306
Office: BMDO
Contract #: F33615-93-C-2319
PI: Bang-Hung TSAO
Title: Refractory Brazing Fillers with Low Vapor Pressure
Abstract: The proposed research addresses the development of several different types of refractory brazing fillers and evaluation of their properties for high temperature and low vapor pressure applications. Refractory metals and alloys are omnipresent in nuclear space reactor assemblies. Joining and bonding parts made of such materials while still maintaining their effectiveness is a major concern. Fabrication with refractory metals requires bonds made at temperatures below the melting points of the pieces being joined. The bonding strength between the brazing filler and the base material constitutes the scope of this proposal. The focal point would be the selection and fabrication of eutectic brazing fillers and the efficient generation of mechanical strength, microstructural degradation, and interfacial phenomenon of the brazing filler and base material. The results of this investigation would be of tremendous importance to the design in selecting the screened and tested fillers from an established data base and lead to a considerable saving in time and effort involved in the design of aerospace related components.

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Topic#: 93-005 ID#: 93-304
Office: BMDO
Contract #: F33615-93-C-2318
PI: Bang-Hung TSAO
Title: SiC Dielectric Capacitor
Abstract: The proposed research attempts to develop an advanced capacitor using SiC for high temperature (400°C), high power, and high density electronic components for aircraft or aerospace application. The conventional capacitor consists of a large number of metallized polysulfone film capacitors in parallel enclosed in a hermetically sealed metal case. Problems with electrical failure thermal failure and dielectrical flows were experienced by Air Force suppliers of the component and subsystem. The high breakdown electrical field, high thermal conductivity, and high temperature operational resistance of SiC compared to the conventional polymer and ceramic capacitor would make it a better choice for the high temperature, high power capacitor. The prototypical capacitor will be fabricated using SiC. The quality of the di trical film will be evaluated. The electrical parameters, such as the capacitance dissipation factor equivalent series resista.ce, and dielectric withstand voltage will be evaluated. Possible failure mechanism will also be investigated and suitable remedies evaluated.

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Topic#: 93-006 ID#: 93-065
Office: BMDO
Contract #: NAS3-27012
PI: Robert Tuffias, PHD

Title: Ultrahigh Temperature Low-erosion Materials for Liquid Rocket Motor

Abstract: The state-of-the-art in high temperature materials for liquid rocket combustion chambers is Iridium/Rhenium (IR/RE), which permits operation to 2200 C. Materials that would permit a significant increase in operating temperature would allow increased performance, decreased weight, and a significant positive system impact for a variety of strategic defense applications. Hafnium Carbide (HFC), Tantalum Carbide (TAC), and their alloys, which are the most thermodynamically stable compounds known and possess the highest melting points of any known materials system, show good potential for this application. Because of their low strain to failure and poor thermal shock resistance, however, fabrication methods and microstructural designs must be developed to improve the toughness of these materials for for them to become viable for engine application. In this Phase I program, Ultramet proposes to demonstrate the fabrication of these ultrahigh-temperature materials and conduct modeling and laboratory analysis in simulated liquid rocket motor environments. Ultramet will systematically investigate the fabrication, design, and performance of carbon fiber-reinforced HFC/TAC composites, leading to dramatic performance gains in liquid rocket motors and the development of technology which will be incorporated into the next generation of commercial satellite propulsion systems.

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Topic#: 93-006 ID#: 93-260
Office: BMDO
Contract #: DASG60-93-C-0135
PI: Andrew J. Sherman

Title: Improved Jet Vane Thrust Vector Control for Solid Rocket Motors

Abstract: Jet vane thrust vector control is one of the least expensive and least performance-impacting methods for thrust vector control. This method utilizes vanes set in the motor plume to deflect exhaust gases, creating lateral thrust. However, the use of high-impulse, high solid content propellants combined with higher pressure motor operation has exceeded the ability of current materials to withstand the exhaust-impinged vane environment. Erosion rates on W/MO and C/C vanes can reach 0.25 to >1.0"/second, which must be compensated for through the use of larger vanes and actualors, which is often impractical. In this Phase I program, ultramet proposes to fabricate and screen tungsten, rhenium-coated tungsten, rhenium metal, and carbon fiber-reinforced HFC matrix composite vanes, leading to a zero- or low-erosion jet vane material for application to tactical and launch vehicles. The materials screening effort will be conducted using instrumented subscale motors with varying aluminum content propellants for which verified scaling relationships have been derived. This will allow analytical determination of full-scale performance, to be verified during Phase II.

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Topic#: 93-014 ID#: 93-063
Office: BMDO
Contract #: F19628-93-C-0122
PI: Qin Jang

Title: Low Temperature Deposition of LAB6 for Field Emitter Arrays

Abstract: Current field emitter arrays have achieved values of normalized transconductance (97 s/cm^2) and average electron current density (1 Ka/cm^2) that exceed the limits of gridded thermionic cathodes by orders of magnitude. The potential application of field emitters to terahertz, microwave, and millimeter-wave source technology, however, is limited by the lifetime of the emitter. In this Phase I program, ultramet proposes to demonstrate the feasibility of fabricating lanthanum hexaboride (LAB6) micron-scalefield emitter arrays have the potential to be operated at lower gate voltages, thus extending lifetime and/or increasing current density.

AERONIX, INC.
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Topic#: 93-003 ID#: 93S01-037
Office: SOCOM
Contract #: MDA911-94-C-0013
PI: Jeffrey S. Ernst

Title: MATT Insertion of Imagery/High-speed Fleet Broadcast Receive Capability

Abstract: The Aeronix Phase I task will address the problem of incorporating Imagery/High Speed Fleet Broadcast (HSFB) Receive Only Capability into the Multi-Mission Advanced Tactical Terminal (MATT) System. The significance of this effort is providing additional capability for field users of the MATT system. The MATT system connects military platforms with secure communications networks to provide tactical intelligence information to a variety of users. The current Built 1 MATT design supports UHF line-of-sight and/or UHF satellite communications with reception, decryption and data processing functions for the TADIXS-B and TRAP data links. Imagery uses compression/decompression techniques to transmit video images over limited bandwidth links. HSFB is an upgrade to the current Fleet Broadcast System (FSB) which will operate in the HF frequency band or narrowband in the UHF band. HSFB supports time division multiplexing of multiple data sources into a common data stream at up to 19200 bps. Incorporations of the HSFB UHF signal and imagery data will be addressed by Aeronix Phase I task. Incorporation of Imagery/HSFB in the core MATT system must be done without adversely affecting system performance. The Phase I task will identify the system requirements associated with insertion into MATT. Architecture tradeoffs will be performed and a top level design will be developed. This design will reflect the baseline for the Phase II prototype kit development (build, fabrication, assembly, checkout and integration).

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Topic#: 93-001 ID#: 93S01-005
Office: SOCOM
Contract #: MDA911-94-C-0005
PI: Robert A. Hunsicker

Title: Aluminum Air Battery for Communications Equipment

Abstract: Proposed program is for the design of a mechanically rechargeable, aluminum-air battery for field use by the Special Operations Forces. This battery will have greater energy storage density by weight and by volume than the BA-5590/U and the BB-590/U batteries commonly used by field communications equipment. This will reduce the bulk and weight of batteries SOF personnel must carry on a mission. Compared to Nickel-Cadmium and Lithium Sulfur-Dioxide batteries, the Aluminum-Air battery will provide greater reliability, increased shelf-life, and be safer for the environment.

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Topic#: 93-003 ID#: 93S01-035
Office: SOCOM
Contract #: MDA911-94-C-0014
PI: Thomas C. Colvin

Title: Imagery/High-speed Fleet Broadcast Receive-Only Capabilities

Abstract: The Government has requested that the Multi-Mission Advanced Tactical Terminal (MATT) be upgraded to include the capability to receive and process the Navy's High Speed Fleet Broadcast (HSFB) data, and the Secondary Imagery Dissemination System (SIDS) data, as defined by the SBIR topic SOCOM 93-003. Mnemonics has assembled an experienced team, familiar with the hardware and software necessary to efficiently evaluate the capability to integrate the HSFB and SIDS into the MATT. Collectively, we understand the MATT hardware, the HSFB system, and the applications software necessary to receive, decompress, and display the SIDS data. The team, consisting of Mnemonics and Information Technology and Applications Corporation (ITAC), in conjunction with SOCOM shall evaluate the alternative hardware and software solutions and the corresponding risks associated with each choice and provide a cost effective solution to the implementation of the HSFB and SIDS. Alternative configurations shall be studied to help span the range of performance and reliability versus cost. The results of the Phase I effort shall be preliminary design representing the choice(s) for best implementation of the SIDS and HSFB capabilities into MATT, providing MATT users with new features without the need for the development of a new platform.

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BMDO Topic#: 93-001
ACCSYS TECHNOLOGY, INC.
CYGNUS LASER CORP.
INTEGRATED APPLIED PHYSICS, INC.
MATERIALS MODIFICATION, INC.

BMDO Topic#: 93-002
CSA ENGINEERING, INC.
HYPER-THERM, INC.
INDUSTRIAL SOLID PROPULSION, INC.
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TG&C ASSOC., INC.

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ONYX OPTICS
PHYSICAL OPTICS CORP.
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TOP-VU TECHNOLOGY, INC.
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CONDUCTUS, INC.
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HYPRES, INC.
HYPRES, INC.

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NEILLEN TECHNOLOGIES CORP.
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KACHINA TECHNOLOGIES, INC.

DNA Topic#: 93-005
KTECH CORP.

DNA Topic#: 93-006
APTEK, INC.

DNA Topic#: 93-007
BRIMROSE CORP. OF AMERICA
FULL CIRCLE RESEARCH, INC.
IBIS TECHNOLOGY CORP.

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FEMTOSCAN CORP.

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MISSION RESEARCH CORP.
MISSION RESEARCH CORP.

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FLUID PHYSICS IND.

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NUMEREX

DNA Topic#: 93-017
INNOVATIVE MECHANICS, INC.

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PHYSITRON, INC.

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HY-TECH RESEARCH CORP.
SCIENCE RESEARCH LABORATORY, INC.

SOCOM Topic#: 93-001
COMMONWEALTH TECHNOLOGY, INC.

SOCOM Topic#: 93-003
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